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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR . ORSON D. MUNN, Editor

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THE fighting power, speed, maneuvershills, and armor of modern tanks have been concounsly happroved over their wardims ancestors. Yet anti-tank defonces and antitation guns have also been improved so that a tenticorps man's job is still nent decor to satisfact from moderation 75mm gam discussed on page 16 will not make it less hasrdons—if the tank in on the receiving end.

18988

50 Years Ago in . . .



(Condensed From Issues of January, 1890)

SPARK PHOTOCRAPHY—"Bife bullets are now photographed in their course by means of the electric spark. The course is taken into a dark room, which the bullet is caused to traverse. As it greates the course, as the product of the course of the product of the course of th

TRAMWAY—"We illustrate a novelty in trainway practice, taken from the railroad operated in the beautiful town of Ontario, San Bernardino County, Cal. The railway passes through the middle of Euclid Avenue, a broad and beautiful street, bordered with orange and lemon trees The avenue is some 6½ miles in length, with



heavy grades as it approaches the hills. The car is drawn up hill and over the levels by a pair of mules, but in going down grades the mules role and the car moves by gravity, as shown in our engraving. A platform with folding sides as provided, which is supported near one end upon a pair of wheels. When the mules are the tractive power the acles of the platform are folded down and the whole rolls back under the bottom of the car, where it re mains and is drawn along the track with the car.

SAFETY—"In his recent message to Congress, President Harmson, laid much stress on the need for dopting means for insuring the safety of railroad employes. An annual death list from accidents in service of over 2000 railroad employes, with the times the number injured, was cited by him as illustrating the urgent nature of the case. He suggested congressional action, requiring uniformity in the construction of cars used in interstate commerce, and the use of improved safety appliances upon such cars."

SHIPS—"Shipbuilding on the Manne coast was more active during the past year than it has been annee the paliny days before the war, when the fleet had the pick of the carrying trade Yards which for years scarcely paid expenses are doing a thriving loanness or dothers for long deserted echo with strokes of adz and caulking mailer."

LIGHTING.—"The controversy now in progress between the promoters of the rival systems of incandercent lighting, though some will think of doubtful expediency, so far as the companies are concerned, admirably serves to acquaint a public now grown timerous, with the detail of operation and with the nature of the presentations which, if employed, would render both systems entirely safe, at least to the user."

PIPELINE.—"The oil pipe line which was receally constructed from Cygnet, Wood County, Onto, Ci Careland, is one of the best in the country, yet it is necessary to watch it vigilantly to prevent any leaks Track walkers pass over every mile of the line each day, about 15 miles being assigned to each man. Every walker is a telegraph operator and is supplied with a pocket unstrument Should be discover a leak in the line, he immediately telegraphs the division apperimendent At stated intervals along the telegraph lines write the carried by the walker. Opening the box, he she key of which is carried by the walker. Opening the box, he attaches his unstrument and

FORTH BRIDGE.—"The practical completion of the great bridge over the Firth of Forth was effected on Thuraday, November 7, when the interesting operation of joining in the center the garder which forms the connecting link between the Inchgarvic and North Queens Ferry cantilevers was successfully accomplished."

- HAND MINING. "When two men can take out \$100,000 in less than a year from a quartr mine, they are doing a pretty good base ness Yet this is what two young men, Messra, Grant and Appel, have done in the Chipps. Flat pocket mine, between Moore's lat Newada County, and Allegheny, Sierra County, And they have no mill, either, simply pounding the rich rock up in a mortar by hand."

WAR SHIP.—"The new British war ship Ricke, lately launched, it is calculated, will be the faster war vessel abon, and, for her class, the strongest fighting ship Displacement, 9,000 tons; leagth, 375 feet, draught, 25 feet, funght, 25 feet, 2

MUSCLE SHOALS—"The obstructions known as the Muscle Shoals, in the Tennesser River, which cover about 23 miles out of the 485 between Chattanoogs and Paducah, at the mouth, are at length overcome by means of locks and dams built by the government, and the river is now open so that boats loaded at New Orleans can at all times proceed to Chattanoogs and most of the time to Knozville The distance from Chattanoogs to New Orleans 1,010 miles.

AND NOW FOR THE FUTURE

Slylon, Newest Contribution of Chemistry to Industry, and What it Promises for the Future.

RAtom Smashers — What They Are, What They De, and How They Do It. By Douglas W. F. Mayer.

RAPplication of Engineering Principles to Dentistri Makes for Better Dentures. By A. W. Jessup.

A Four-Lane Highway Bridge that, for a Mile of its Length, Floats on the Surface of the Water. By Charles F. Monro.

Personalities in Science

E VERY person who wears glasses owes to Dr. Edgar D. Tillyer, internationally known lens authority, a debt of gratitude so great that mere words cannot express it. His brilliantly creative mind has contributed more than a hundred important developments in the field of optical science.

Intracate scientific problems are al ways tempting to Dr Tillyer. A small man with a large domed head crowned by a mop of gray har, he'll seize a pad of paper and cover it with an astonishing array of mathematical computations. Out of these complex calculations will come a new lens system, a new eye-testing instrument, a new lens-measuring device or, just for relaxation, new developments in the motion picture or radio fields.

Dr. Tillyer was born at Dover. New Jersey, December 7, 1881. A graduate of Rutgers University, his first position was that of Computer with the Nautucal Almanac Office at Washington, D. C. In 1907, he became an Astronomical Observer in the Naval Observatory at Washington. Four years later, he entered the Bureau of Standards in the

same city. Then, in 1916, he accepted the invitation of the American Optical Company, Southbridge, Massachusetts, to direct its Research Laboratories. While at the Naval Observatory, Dr Tilly designed and built the clock vault temperature control and also de-

signed a pair of astronomical photographic lenses for the observatory.

As a member of the Bureau of Standards, he performed a notable service:
He revised the old types of submarine periscopes and wrote the then standard periscopes and wrote the then standard periscope specifications of the United States Navy. He also determined and wrote guanish specifications for the

During the World War. Dr. Tillyer did spiendid work for the United States Coverament. One of his conspicuous achievements was re-designing a telescopic sight for the French 87-milli-meter timk-repelling gun. The herium crown flase smed in the former gunsight as not obtainable here in sufficient santifies and soveral of the largest lem nanufactures declared that this gunsight had to be made of harium glass that Tillyer re-designed the lens systems.



EDGAR D. TILLYER

tem, using plain optical glass. Trials showed that the telescopic sight using ordinary spectacle glass was more efficient than the French barium glass sight

Perhaps the best known of the scientist's developments is the Tillyer lens, a highly significant development which took years to perfect

took years to period to come out of the American Optical Company Research Laboratories—the successful grinding of Polaroid van glasses to prescription after five years of intensive experimentation.

In the motion-picture projection field, Dr. Tillyer is the inventor of the automatic heat screen—a leas in the projector system which will transmit the light rays and retard the heat rays, thereby preventing the film from burning when the machine is stopped. In the radio field, among other things, he devised one of the widely used methods of cutting quartz crystals for radio frequency centrol.

Dr. Tillyer's supreme delight is the

development of new types of glass. At the present time, he is working on radically different glass compositions. Tantalizingly, with a tiwikle in his eyes he refuses to talk about these new glasses, but does admit that one group has the property of not dissolving in hydrofluoric acid which dissolves all ordinary glasses.

Seemingly, Dr. Tillyer lives for science alone, but this is far from the truth Genial, possessed of an excellent fund of stories, his tastes are catholic and his hobbies many. Intensely interested in photography, nothing pleases him better than to project his excellent collection of colored photographs for his friends. He loves to fish and cheerfuly admits the fish generally elude him. His badminton is not what it might be, but he enjoys the game anyhow. As for bridge, rumor has it that he has developed a new system which, unfortunately, does not prove infallible. In respect to literature, he states with refreshing candor that he likes nothing better than an exciting detective varn



X RAYS REVEAL THE SECRETS BENEATH ITS PAINT



Above The famous "Ashbourne" portrait of Wil-liam Shakespeare, owned by the Folger Shake-speare Library, Washington, D. C., now, for the first time, dissected with infra-red and X-ray photog.

To comparison with the skull in the "Ashbourne."



Figure 1 Left: Edward de Vere 17th Earl of Oxford and Lord Chamberlain of England. Born April 12, 1550, died June 24, 1604 Painted in 1575 when this mysterious poetpeer was 25 years of age. From the original owned by the Duke of Portland

Figure 2 Right A heretofore unpublished por trait of Lord Oxford, identifiable as the work of Marcus Gheraedts. "Il has frequently been reported," says A Wwell (1827), "that Marcus Gheraedts had painted Shakespeare, but nobody knows whence it originated." Painting owned by the Duke of St. Albass



IDENTIFYING 'SHAKESPEARE'

SENSE of mystery has always sur rounded the personality of Shakespeare, the prince of dramatists, as compared with the citizen of Stratford on-Avon who signed himself-evidently with painful difficulty-Willin Shakspere. The latter left no letters, manuscripts, books or other relics of creative endeavor Both of his parents, as well as his own 26-year-old daughter, were so illiterate that they could not write their own names, as the village records testify. Will himself is stated by two 17th Century investigators to have been working as a butcher's apprentice up to the time he left his wife and three small Science in the Shape of Infra-red Photography and the X ray Brings to Light at Last the Real Man Beneath the Surface of a Series of Paintings of the Bard

By CHARLES WISNER BARRELL

children to seek his fortune in London There is no contemporary citation of his ever having attended school a day in his life or of having received any training whatever in any of the liberal arts with which Shakespeare, the dramatist, shows such intimate familiarity. Finally, during the heyday of the playwright's creative career, the Stratford citizen appears in the annals of his native town as malt dealer, money lender, and land speculater.

While it is entirely possible that this jack-of-all-trades may have had some



Figure 8: Lord Oxford's head, enlarged from the Portland portrait



Figure 4: Shakespeare's head. To be compared with those of Oxford



Figure 5. Lord Oxford's head enlarged from the St. Albans painting

THE accompanying article, on a subject which may at first strike the reader as literary rather than scientific, if published in Scientific American because its major promise is in the realm of science the recent findings of the X-ray and infra-red nbetgeraphy.

Was Shakespeare really the man of Stratford-on-Avon, or was he someone else? Why go out of the way to question the familiar behef that he was simply himself—do we not know his life? Unfortunately, we do not As George Steevens, early English Shakespearian scholar, once said:
"All that is known with any deeper
of certainty concerning Shakespeare
is, that he was born at Stratford-onAvon, married and had children
there; went to London where he
commenced actor and wrote poems
and plays, returned to Stratford,
made his will, died and was buried;
war about the identity of Shakespeare, likely now to enter a fresh
phase based on the new findings of
science, the editors of this magazine
remain neutral —The Editor

business connection with the London theaters, it has been difficult for many students of his personal life to see in him the profound philosopher and cosmo politan artist who wrote "Hamlet" and some 30 other masterineces.

As a result, fully a thousand volumes have been published in the past hundred years, vigorously disputing the claims of Willim Shakspere to the rank of Number One literary genus of the race

The main contention of thesautiStratfordians is that "Waltiam Shakespeare" was a pen mane. like "Moltere," "George Eliot" and "Mark Twain," which in this case cloaked the creative activates of a master scholar in high circles who did not wish to have his own name—or title—emblazoned to the world as that of a public dramatist It is a well-known fact that the stage was held in social divespute in the Elizabethan age. On the statute books, "wagabonds, threes, and players" "wagabonds, threes, and players"

were lumped together as undesirables Creative poets then were not by any manner of means accorded the same de gree of reverence that they now com mand as "classics" "The Arte of Eng lish Poesie" (1589), first comprehensive analysis of the subject, makes the follow ing significant statement " . in these days (although some learned Princes may take delight in Poets) yet universally it is not so For as well Poets as Poesie are despised, and the name be come of honourable infamous subject to scorn and derision, and rather a reproach than a praise to any that useth it " This work is but one of many testi fying to the low estate occupied by Elizabethan poets generally

D URING the course of the debaterelating to the real personality be hind the Shakespearan work, much contemporary evidence discovered in the past 20 years has led modern inwestigators to believe that Edward de Vere 17th Earl of Oxford really had a much more intimate connection with the immortal plaws and poems than has been realized heretofore More than 30 volumes have been issued in presentation of Lord Ox ford's claims

The same mysterious incongruity that surrounds the disputed personality of the dramatist also shrouds the paintings that have been known for many generations as "life portraits" of the Bard.

There are at least 12 of these, some on canvas, some painted on ancient wooden panels, which many art experts agree



Figure 6 Oxford's hand, St Albans portrait Note long thumb and wild boar device

Figure 7 Shakespeare's "Ashbourne" hand Note long thumb, signet-ring, gauntlet

are of indoubted Elizabethan or Jacobean composition Several of the pictures are inscribed with dates that fit into the Shakepicarean chronology, though none of approved technical ancientry bears any discernible name or artist's mark on its surface.

Until the early part of the 19th Century, six of these paintings had been held for unknown periods—evidently from the same age in which the Shakespearean plays originated—by various members of the old English aristocracy. It is significant that none of them can be shown to have had any Stratfordian ownership connections whatever. Moreover, were few of the works had until comparatively recent times ever heen put up for sale or otherwise exploited publicly One of the most interesting of them, which pictures the poet rochly garbed, was taken from the Tudor collection in Windsor Castle by Queen Victoria for presentation to Lord Lytton, the avoidant As a matter of fact, eight out of the 12 genuine Renaissance studies of Shakeparare, as listed by the "Encyclopaedia Brittanca," depict him wearing the unmatiskable sture of a noblemmatiskable sture of a noblemmatiskable.

To explain this remarkable circum stance. Stratfordian writers have conjectured that Willm Shakspere may have been painted in stage costume But this theory lacks corroboration from contemporary sources. Among the aix or eight authenticated portraits that exist of other prominent figures in the Shakespearean theater, such as Richard Burbage, Ben Jonson, Ned Alleyne, William Sly, and John Lowen, not one is delineated in any such fashion. On the contrary Eliza bethan actors and dramatists—with the one outstanding exception of Shake speare—sat for their likenesses in sober. unobtrusive garb. During the days of Good Queen Bess, as official annals state. sumptuary laws regulated the wearing apparel of the classes quite as strictly as our modern statutes regulate the use of police uniforms

So when we find a number of tradtional portraits of the Bard which show him sporting the dress clothes of the Elizabethan nobility, excellent prima face evidence would appear available to suggest that he may actually have been a member of the privileged class, just asthe Baconians, the Oxfordians, and other heritard disblessers in the Computational



Stratford legend have been contending, all along.

Acting on this hitherto strangely neglected hint, and having familiarized myself with much of the essential testimony in the case of disputed personalities, pictorial and otherwise. I secured permission about two years ago from the owners of some of the best-known Shakespeare paintings to investigate them with the modern scientific media of infra-red and X-ray photography

It seemed possible that un derneath the outer coats of one or two of these ancient works might he concealed some key to the mystery that has puzzled so many students throughout the centuries

The paintings finally so lected for dissection include the half-length panel owned by the King of Great Britain at Hampton Court Palace. the head and bust panel. known as the "Janssen," owned by the Folger Shakespeare Library at Washington, D C, and the three-

quarter length canvas, generally called the "Ashbourne," which is also now the property of the Folger foundation

In each instance, my technical assocrates and I have uncovered clear-cut evidence to show that details of the original portraiture have been changed and that certain areas which previously displayed symbols of personal identification have been completely painted

The manner in which this work of concealment and disguise was carried out, the character of the brush strokes employed, and the present condition of the surfaces of all three pictures, make it apparent that the changes were made at some remote period. It also seems



Figure 11: Shakespeare's signetring. Note under-surface shadows. plus broken surface outlines, forming design of a wild boar's head



Figure 9 Infra-red closeup, Shakespeare's head. Note raised forebead, under-surface outlines of original ruff

evident that the hand of the same fur tive craftsman was utilized throughout Comparative research on recovered details of the original compositions and on all personal symbols of both the sitter and the artists who painted him. now for the first time brought to light. show beyond reasonable doubt that the Shakespeare who appears in these works must have been the mysterious



Figure 10 The wild hoar device of the Earls of Oxford. From a Tudo: MS published by Lord Howard de Walden Compare with Figure 12

Elizabethan court poet, Edward de Vere 17th Earl of Oxford, and not the member of the illiterate Shaksperc family who was buried at Stratford-on Avon, April 25th, 1616

Before discussing in detail the evidence brought to light by study of these paintings, it is appropriate that certain background facts be given on this poetical Lord Great Chamberlain of the Shakespearean age As contrasted to Willim Shakspere the elusive business man, Edward de Vere, who "wasted his substance" and squandered his patrimony on men of letters, was intimately associated with many of the best known

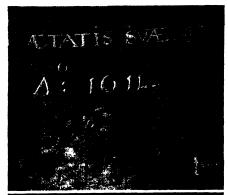
playwrights of the day, acted himself, patronized several companies of players, and was acclaimed by leading Elizabethan critics as the 'most excellent" of all the Court poets—"the best for comedy among us" The personal drama of Lord Oxford's own life is realistically presented in a dozen or more of the Shakespeare plays, while the literary nobleman's personal letters have been found to abound in situations, points of view, and more than 150 dramatic figures of speech that reappear in the plays and noems

CHAKESPEAREAN schol are have never been able to account for the Bard's ob vious knowledge of Italian and French literature in the original Shakspere of Strat ford never traveled on the Continent Edward de Vere. however, not only visited France Italy, Germany and the Lowlands, he spoke, read and wrote Latin, French and Italian fluently His social

position as the premier earl of his era would account for his familiarity with manners, customs and speech at Court Presented with an honorary degree at Oxford, he was told by the orator of the day-who later figured as an early com mentator on Shakespeare's works--"thi countenance shakes a spear." A mem ber of Grav's Inn Society of legal lights. he had an intimate knowledge of lawreflected in all the plays Largely because of his addiction to the company of bohemian writers, poets, musicianand mountebanks. Lord Oxford fell afoul of the taboos of his class. Shakespeare in the "Sonnets" bitterly laments the loss of "good name" and social prestige This would account for the



Figure 12 . The original boar's head design of Figure 11, restored by outlining under-surface shadows on the matrix with white paint





C 1939 by C W Barrell



Figure 13 X-ray exposures covering inscription area of "Ashbourne" painting. Note under-surface remnants of original lettering; also family crest and shield of arms, with artist's monogram below phantom scroll

Figure 14 Left: Close-up of the X-ray monogram, C K Below, center · Cornelius Ketel's monogram from his portrait of Sir Martin Frobisher in Bodleian Library.



Directly below . Two more examples of Ketel's monogram, showing his habit of combining the initials CK in varying forms



adoption of a pen-name by the author of such sentiments.

Through the courtesy and co-operation of the present Dukes of Portland and St. Albans, our investigation has been provided with complete technical descriptions and photographic copies of the only known paintings of the Earl of Oxford which bear his name, dates and personal symbols, undanguised. Study of these two pictures, Figures 1 and 2, in direct comparison with any one or all three of the dissected Shakespeare paintings, discloses not only an extraordinary similarity of the features in the original drawing but-allowing for the fact that different artists with different points of view turned out the works-an absolutely convincing repe tition in physical color schemes Lord Oxford has reddish brown or auburn hair, a complexion merging from pink to carmine eyes of light hazel, that is, blue-gray with inner rings or flecks of copper, high-arched evebrows, a Roman nose with well defined nostrils, a long upper lip a well cut mouth of generous proportions and mustache and beard



Figure 15 The shield of arms of Lord Oxford's second wife, From the 16th Century Lane-Trentham monument in St. Peter's Church. at Wolverhampton, Staffordshire. Compare placement of the three griffins' heads in profile with remnants of the heads on the hidden cout of arms in the Shakespeare painting which X rays disclose

running through shades of sandy-red to dark auburn.

With the exception of a somewhat shortened nose and a partially bald head, the crude stone memorial effigy of Shakespeare which was set up on the wall of Trinity Church, Stratford, some time prior to the publication to the First Folio, originally displayed exactly the same facial color scheme that appears in the Lord Oxford portraits. We know this from a record made by

(Please turn to page 43)

OUR POINT OF VIEW

Science Transcends War

UST as two boys, starting from a TUST as two boys, starting trifling injury committed by one against the other, work themselves by progressions into a full-fledged fightfirst a light slap, then a heavy swat, next a solid cuff, then a kick and soon a clinch with nothing dirty barred-so do two opposing nations at war work by downward steps into methods which do not har hitting in the clinch, biting off ears or tips of noses and gouging out eyes The present war shows normal evidences of progressing in these directions despite the probable wish of each side that the play might be kept clean, so to speak; for in the nature of things. or until nations miraculously take to saving "You bit my ear off so we will slap your wrist, and then let's both change to calling names and making faces," this is inevitable

It is therefore a satisfaction to the scientific to observe that their own kind among the warring nationalities are not so childlike. In the yournal of world science. Nature, published in London, we find the following as a comment on the 90th birthday of the noted German physiciast von Laure. "We take the opportunity to congratulate him on his brilliant scientific work which has led to the development of more than one new and important branch of science." The spirit of science. "A. G. I. The spirit of science. "A. G. I. The spirit of science." "A. The spirit of science." "A. G. I. The science "A. G. I. The spirit of science." "A. G. I. The science "A. G. I. The science" "A. G.

"As She is Spoke"

APOLOGISTS for slovenly use of the English language by many Americans say that such use is a sign of virility, of a bealthy, growing language. Usage, they say, gives a patent of respectability. The inference is that if slang words are not frequently adopted into the language and other words and phrases are not consistently misused, the language is decedent.

We disagree violently with these condoners of mental sterility and lassitude. We could cite scores of cases in pointfrom everyday speech, articles, business letters, novels-to show that sound English and robust words would have been more expressive and, certainly, less ridiculously infantile. But this journal is interested in the humanization of science, and so we will confine our remarks to one of our particular betes noire in that field. This humanization requires skilful, accurate reporting of facts, the use of apposite analogies, and such a simplification of technical description that the result will be lucid enough for the average newspaper reader's understanding. It is in this attempt to simplify a scientific subject that this beast often rears its ugly head

Over and over again one reads that something is "three times smaller than" something is when "one third as large as" was intended Or it may be "two thirds closer than" as the New York newspapers distorted the recent report from a great university that certain heavenly bodies were believed to be only "one third as far from," the earth as had been previously estimated

"Three times smaller!" "Two thirds closer!" How small is small? How close is close? One may as well ask the little boy's question "How far is un?" By what simple rule of arithmetic does one multiply downward, multiply a unit -whether it be a number or an object -and get a fraction thereof? There is nothing absolute about "small" or "close" Both, indeed, are abstractions. and we can see no sane reason for any writer to go through all sorts of mental contortions to give them new, definitive rôles. We have simple fractions already assigned to the jobs that would be forsted off onto such meaninglesphrases. We should use them We should in fact, do everything in our power -we science writers-to make lucid for the layman, and accurate, the science which we wish him to think of as being human.--F D M

Accomplishment

OCCASIONALLY even a supposedly blase editor, whose daily task in volves participation in a critical survey of the passing parade of scence and industry, stops short with a mental gasp of sudden realization Day by day he has seen in the parade examples of progress in some one industry, has accepted and helped to report them as part of the usual routine. Then comes the gasp. Something happens to make him acutely aware that these individual examples have coaleseed into a whole, the implications of which are so first reaching as to challenge the imaginaries of the state of t

Such has been the case with the plastions industry; the shock which produced the mental gasp was the recent announcement of the results of the annual Modern Plastics competition. For years Scientific American has followed the course of plastics through sahtrays and airplanes, industrial applications and home uses, yet nowhere has there ever before been brought out so vividly the impression which the entire plastics field has made on so many phases of our everyday life-at home, at work, at play

Here is an industry, if there ever was one, that owes not only its very existence but its present importance to individual initiative and a keen desire to produce new materials that will do old jobs better, as well as to create new products for new purposes First came Celluloid. made in an effort to replace ivory in billiard balls Then a long hiatus until Bakelite sprang from a laboratory marriage of two bounds and firmly estab lished itself in the electrical field. Later developments with this last-named plas tic opened new and varied uses for it Then came other plastics, other developments, other applications

This brings us to the latest Modern Plastics competition, in which over 800 entries made from a wide variety of plastics strove for the attention of the judges. Here were displayed plastics parts for machine tools, large casings for various types of business machinery, beautiful decorative pieces in wide color ranges, molded door liners for refrigerators, plastics tools and dental plates. jewelry and automotive parts . Over it all hung a tremendously encouraging aura of progress, of accomplishment What the scientists of the plastics industry have done in creating new ideas is typical of the spirit of industrial progress that has made our civilization the worthwhile thing that it is today Our sincere congratulations to the men who have made possible this remarkable development: that they will attain even greater heights in the future is completely assured -A P. P.

Air Power

All speed records don't always mean. In the what they seem to mean. In the United States, the top, speed of a plane as determined by flying a measured course, the plane entering the course from a level flight and continuing so in Germany, on the other hand, the plane enters the measured course from a power enters the measured course from a power care to the course of the course the measured course from a power care race favours themselves.

Perhaps this fact may partly explain why 27 German Messerschmidts, supposedly such superior fighting planes, were so easily detented (with nijournal downed and the other 18 routed) by only nine Curtiss fighters piloted by Frenchmen. And that brings up other conjectures. Has this "handicap method" been widely employed in estimating other aspects of Germany's air power? It may have been; and if so, it may explain Germany's few air successes in recent weeks. We wonder.

To Combat Noise

Total decades, men were too busy pushing along our industrial advance to be concerned sertously with new moses that came with new machines, these were a necessary evil, and that was that But in recent vears they have come to learn that there is more nones has flower to noise than the sound we hear Some nones. Satiguing to men and the machines they run. It may seriously affect normal digestion of persons continuously exposed to it and it frequently is a sign that the machine is not performing all of the work of which it is

capable In noisy industrial employment it is not unusual to find as many as 50 percent of the workers under 30 years of age with some degree of impaired hear ing, according to Dr Carey P McCord of Detroit, chairman of a special noise study committee of the American Med ical Association In addition to car in juries, this authority points out, there are many more scarcely measurable effects such as loss of sleep excessive fatigue, and emotional disturbances, which are brought about by noise Fa tigue caused by noise probably effects the initial injury to the ear in such cases of industrial deafness, the doctor states, with the changes taking place in the tissues of the ear, their location and extent of damage depending on the type of noise and the duration of the exposure

STUDIES have indicated that high pitched tones are more damaging to the health of workers than low pitched tones. The din in a boil works is more injurious than the lower-pitched roasing in a cotton spinning mil. The report of small caliber ar tillery and machine guns is more injurious than the boom of heavy cannon.

All recent noise studies indicate not only that workmen do better work when freed from the most disturbing noises but that most of us would lose some of the jittervness of 20th Century living if we were inoculated with a little more quiet.

Now, consider the machine for a moment Sound is the result of something vibrating within the audible range. We hear it because the vibration object causes alternate expansion and contraction of the atmosphere surrounding the object, and these pressure changes are transmitted in waves to all points in the neighborhood of the source of the sound, exerting a pressure on any object, such as an eardrum, One Device Dissects Noises, Analyses Them...A Second Finds Vibration Sounds . . . A Third Determines Expansion of Metal Which Makes Hum

By JAMES A. BAUBLE

within its sound field. If the vibrations are excessive and are coming from a machine, they are more than likely a warning that the machine is laboring under some difficulty, is not working efficiently.

As a result of these demonstrably harmful effects of noise on the tools of industry the worker, and in fact the

entire citizents, engineers physicisma and municipal administrators are hattling more today as never before attacking it in hundreds of laboratories and conicidanders. Di. McCord is of the opinion that 90 percent of industrial noise could be reduced to one half of its present intensity, if the causes of noise were discovered and corrected.

Today this goal is with me the real of possibility partly because of the work of a group of research engineers in a dozen laboratories of the Westinghouse Electric & Manufacturing Compan Out of these laboratories has come a mechanical detective to search out unwanted sounds. This noise detector,

developed by W. O. Osbon, not only measures the intensity or loudness of a sound but diagnoses its nouse, separating it into its different parts and measuring the pitch and intensity of each part.

The noise analyzer looks and acts something like a radio receiving set of an earlier vintage. On its panels are



Co-developer of the Dynetric Balancer which sees and feels where and how much a rotor is off balance, F. C. Rushing focuses a Stroboglow lamp on a rapidly revolving rotor



The inventor of the portaable noise analyzer, W. O. Osbon, right, is shown measuring and diagnosing the noise inside a motor coach. This is the machine that breaks noises into all their parts for close study switches, dials, and meters. Inside are vacuum tubes, condensers, and transformers. But to understand how it works, it is first necessary to inquire a little more into the cause of noise.

Technicians in the science of sound have agreed upon a barely audible sound of 100 vibrations a second as their standard of reference Such a sound as this presses upon each square centimeter of an eardrum with the force of one five-thousandths of a dyne or approximately three billionths of a pound per superior sound sound



The control panels of the unique device which measures the lengthening effect of alternating current on magnetic metals, and developes S. L. Burgwin



Half the size of a dime, the tiny mirror at the left reflects a light beam into photo-electric cells to measure the amount of "stretch" of steel The mirror is on a needle which rolls under the bar to the right of the pincers

square inch. As the sound increases in loudness, the pressure exerted on the eardrum increases tremendously. For example, if a barely audible sound of 1000 vibrations is increased in loudness to the threshold of pain it will exert a force of 3000 dynes or about one twenter of a power of the pressure inch. Its pressure has been increased about 15 million times.

BUT pressure or intensity alone does not determine the loudness of a sound. This depends rather upon the combination of the sound's frequency tunniber of vibrations) and its intensity. If two sounds are of equal loudness but have different frequencies, the one with fewer orbitations will in general, have a greater intensity at its source and exert a greater pressure on the eardrum.

The human ear is sensitive to a range of frequencies from 16 to 22,000 cycles a second, but is most sensitive between 1000 and 5000 cycles. If the intensity of sound increases 10 times, its intensity level rises one bel, in acoustical terminology. The decibel is one tenth of a bel Some noises become so intense that they are felt as well as heard; they are then said to be on the threshold of feeling This occurs only in the upper limit of audibility, near 120 decibels for some sound frequencies. The purring of the

family cat rates about 25 decibels. A pneumatic drill at a distance of 10 feet produces a noise level of about 90 decibels.

These air the elements of sound that are timed in by the noise analyzer. The frequency of every component or contributor to noise is balanced by this hearing mechanism against its own mechanical filter's frequency of 7000 yibrations a second

As the sound engineer sweeps through the analyzer's frequency range, its decibel dial indicates loud noises at specific frequencies, instantaneously recording all the varying contributors to the total noise output of a machine or apparatus under examination. It singles one element out of a dozen possible elements that make up a noise.

Already the supersenative ears of the manalyzer have uncovered eliusive noises in street cars, airplanes, trains, and electric motors. It has separated the electric motor's noise, disgnosing it and placing place to the hame where it belong it tellishow much noise is caused by unbalance in the rotor, how such the source of the motor of the rotor, and what part is gear noise.

Housewives usually have scant interest in rotors, generators, and the machine noises of factories, but today they have the analyzer to thank for the quiet operation of their electric refrigerator, washer, ironer, vacuum cleaner, and many other small motor-driven home appliances. In all these, the analyzer has done yeoman's service in uncovering noise sources.

In another laboratory at East Pitts burgh, engineers recently set a new electrical sleuth on the trail of noise well-test and the state of the set of the

STIL another new comer to the ranks of none detectors is a device devel oped by S. I. Burgwin, a Westinghouse rewards engineer, as a mean of studying the property of magnetic metals to lengthen and houten in an electromag netic field. Engineers have long known that in most electrical machines using alternating current the iron is first magnetized, and then magnetized in the opposite direction. Frequently the resultant lengthening and shortening of the metal in electron and studying the studying the pressure waves in the air, audible as huzzing of humming noises.

In working out the machine, Mr. Burgwan sidestepped several handidaps by developing an "electric eye" yardituck, using direct current to measure the simple change in length of steel test strips, detecting improvements and failures in new electric metals. Stripped of its technical direcs, this measuring machine consists principally of a tiny toller, about the size of a darning needle, on the end of which is fastened a mirror about half the size of a dime. A divid q photo-electric cell and a light beam complete the setup.

When a test strip is placed on the roller and magnetized by direct current, it lengthens. The light beam focused on the mirror is reflected to the photo cell, registering the amount that the roller turns, determining the elongation of the test strip. The deflection of the light beam may be as small as four ten thousandths of an inch at a distance of about 39 inches from the source of the light beam, by using a galvanometer, the photo-cell magnifies this deflection 100 times makes it readable.

Fifteen year, ago engineers knew very little about noise. Paradoxically, they learned how to sop noise by developing means of producing it in radio receivers, virtually building the modern science of sound around the radio microphone. From this beginning the mudurtal research laboratories have come to solve mose problems that were not even dreamed of in 550 a.c. when Pythagoras dounded the science of sound with his mathematical explanation of the musical scale.

DUST CLOUDS OF SPACE

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson
Observatory of the Carmage Institution of Washington

Since Barnard's classic work, more than 20 years ago, it has been realized that the dark "irtfa" and "lanes" in the Milky Way, and the smaller black spots which are found here and there, are not gaps or holes in the star clouds, through which we look into the black depths of space beyond. They are obscuring clouds, which he in front of the stars and hide them

If a cloud of this sort were perfectly opaque, we might expect it to appear as a black, statless spot in the heavens, and so it would, if it were only a few light-years away. But a black cloud at a distance of 100 light-years or mould have many stars in the clear space in front of it, and these would appear scattered over the dark patch in the sky. But if the cloud were only partially opaque we would also see, in the obscured region, stars lying behind the cloud, dumnished in brightness by the absorption of their light but not extinguished.

How may one distinguish between these two possibilities? The task would be easy, if the stars were all of the same real brightness, for then the apparent brightness would be a direct clue to the distance If a black cloud lay at the distance at which the stars (on our momentary assumption) would appear of (say) the eighth magnitude, we would find as many stars brighter than this limit in this part of the sky as elsewhere, and none at all which were fainter But if the cloud let through one sixth of this light-that is, made a star seen through it appear two magnitudes fainter-the stars behind it, at such a distance that they would appear. in clear space, of magnitude 9, would be reduced to magnitude 11, and so on. We would still find faint stars in the region but in reduced numbers as many tenth magnitude stars per square degree as there were twelfth magnitude stars outside, and the like By simply counting the number of stars, for equal area, inside and outside the obscured region, we could thus find very easily the distance and opacity of the cloud

Actual conditions are, of course, much less simple—the cloud may be a thin fog, extending to a great depth and obscuring more and more the stars which the deeper in it; and the star which the deeper in it; and the star should be really the second—ware arout the sharply defined effects which would appear in the first case, and make the calculations much more complicated. But, with accurate observations of the braichness of

stars in obscured and unobscured regions—numerous enough to get good average values, and running down faint enough to get away from most of the snearing effect—it is possible to determine prefix reliably the distance, the total absorption and even the thick mass of the foggy region. We must start with knowledge of the relative numbers of stars of different degrees of real brightness, in the same volume of space, but this can be found in other ways.

It is rare to find a really black cloud There are a few spots where hardly 1 percent of the light from behind getthrough, but in most regions-such as the Coal Sack near the Southern Cross the background stars are still visible but appear reduced to from a quarter to a tenth of their proper brightness The total light of all the stars-except the foreground-is reduced in this proportion so the dark patch will be conspicuous, provided that it is near enough to us so that the "foreground" stars give only a moderate percentage of the whole light This happens, in the Milky Way. for clouds which are only a few hundred light years distant. But a cloud-even a very big and black one-two or three thousand light-years away would have such a lot of unobscured stars in front of it that its existence would not be obvious, and careful counts of stars. down to very faint magnitudes, would be required to find it.

THERE is one way, though, in which these distant clouds can be detected They hide the spiral and other extragalactic nebulae, which lie far, far away, enormously outside the outermost confines of our own Galaxy. It has been known since Herschel's time that very few such nebulae were found in the parts of the sky near the Milky Way, and Hubble, by detailed surveys, has mapped out a "zone of avoidance" extending all around the heavens in which none at all of these distant bodies can be observed. Evidently, in the outer regions of the Galaxy, or perhaps beyond most of its stars, there must be gigantic obscuring clouds, which shut out hopelessly from our sight a great portion of the remoter Universe There are a few places, though, not far from the central line of the Milky Way, where Hubble has photographed extra-galactic nebulac. Here there must be "holes" where the incoming light passes between the clouds, whether near or far, and reaches

These obscuring clouds are the hugest things known to astronomy, except the great spiral nebulae themselves. Even our near neighbors among them—in our own Galaxy and but a couple of hundred light-years away—have length, and breadth and thickness which must be measured in light years.

Their enormous size, however, must be compensated by an excessively low density The only known thing which can be at the same time so rarefied and so opaque is an enormous, thin, cloud of dust. An easy calculation shows that the light-obscuring power-per pound per million cubic miles - becomes greater and greater, if we imagine the material in the cloud to be broken up into finer and finer dust, until the dust particles are reduced to a diameter of about 1/150,000 of an inch-so that their circumference is equal to a wavelength of light Still smaller dust gets a decreasing grip on the light-waves and the opacity rapidly diminishes as it gets finer.

When we say that the obscuring clouds are composed of such fine dust, we do not mean to suggest that other particles may not be present—from the obscuring and the obscuring the obscure

There is an important difference, though, in the properties of a cloud, according as it is composed of perticles decidedly larger than 1/150,000 of an inch, of particles decidedly smaller, or of a mixture of both.

In the first case, the obscuration is by ordinary opaque-body obstruction, and light of all colors is affected to the same degree. In the second, when the particles are much smaller than the waves of light, they have far more influence in scattering short waves than long, and the blocking power varies inversely as the fourth power of the wavelength For red light, say of 5000 ang-

Despite Unavoidable Complications, It Has Proved Possible to Determine the Distance, Light Absorption, and Size of These Obscuring Clouds

stroms, the effect is only one fifth of that for violet light (4200 A)

Now it has been known for many years that a good many stars in obscured regions of the sky appeared abnormally red This adverb suggests another complication Stars of different temperatures naturally give off light of very different average colors, but, fortunately, there is a close correspondence between the color and the type of spectrum as defined by the lines in it By finding the normal color for stars of each spectral type, in regions clear of absorption, we can get standards with which to compare stars in the obscured regions, and, fortunately, we have a good test for freedom from absorptionnamely the visibility of extra-galactic nebulae The "color excess" measures directly this abnormal reddening and hence that part of the obscuration which varies with the wavelength

An admirable research of this sort of this sort has just been reported by Stebbins, has just been reported by Stebbins, Huffer, and Whitford, who have for years been making highly precise photometric cells, first at the University of Wiscomin, and later at the University of Wiscomin, and later at the University of Wiscomin, and later also at Mount Wilson. It has been no parameters results derived from observary to the present paper summarizes results derived from observary to the property of the property

WORKING with two color filters, transmitting violet light of average wavelength 4170 A, and blush-green at 4710, and with a thermionic amplifier to magnify the minute photoelectric currents, they have made precise measures of stars fainter than the tenth magnitude, though in general they stopped at about the minth. The color reached of a star thus measured has a probable error of 00 to 0.02 magnitudes—about 1.50 of the difference in color between Vega and Arcturus, which, on their scale of measurement, is 0.7 magnitude.

Outside the Milky Way, and, indeed, in the portions of it well away from the central line, there is not much abnormal reddening. The strongly reddened stars are close to the central line, and a plot of these alone would suffice to map out the galactic circle Moderately reddened stars (with a color excess less than 0.30) are found all round the Milky Way. But the strongly reddened stars not only cluster close to this circle,

but are numerous in the region of Sagittarius (which lies in the direction of the galactic center) and are absent from a long stretch of the Milky Way in the opposite part of the heavens, where we are looking away from the center, and toward the edge of the great, roughly disk-like assemblage of stars. It is close to the center that the reddest B aters are found. One has a color excess of 90%; that is, though it ought normally to be whiter than Vega, it looks almost as red as Arcturus.

In both parts of the heavens, strongly and slightly reddened stars of nearly the same apparent brightness are found suggesting that the obscuring clouds are patchy, with some nearly clear gaps be tween them This is confirmed by a detailed study of regions where bright star clouds he close to dark and obviously obscured regions. In the bright patches, the stars are slightly reddened indicating that there is some absorption all over this part of the sky. In the moderately bright regions adjoining, the B-stars are conspicuously redderthe absorbing layer is denser-while in the darkest regions no B-stars are found at all. The obscuration has made them so faint that they drop below the limit ing brightness of the survey

So far, we have considered only the the light which passes through them It is of great interest to find, if one can how much they weaken the light of vari To attack this problem ous colors Stebbins and his associates have chosen pairs of stars close together in the sky and with very similar spectra, one of which was abnormally red and the other not. If the spectra are substantially identical (as regards the intensities of the lines) we may assume that the real temperatures, and colors of the light are substantially the same. These pairs of stars were then observed with a spectrophotometer, measuring the rela tive brightness of the two in many separate small regions of the spectrum. To measure these small separated parts of the radiation of a seventh-magnitude star must have demanded extraordinary precautions, the authors only remark "A cesium oxide cell refrigerated with dry ice was used

The reddened stars, of course, give relatively more red light; but, when the excess brightness was plotted against the wavelength, it became evident that the rate of change with color was not nearly as great as it would have been for an absorbing cloud composed en tirely of gas and exceedingly fine dust The variation was not inversely as the jourth power of the wavelength, but inversely as the first. This is not theo retically troublesome-it can perfectly well occur for light which has traversed a mixture of dust particles of varying sizes But the practical consequences are interesting. With this law of variation the obscuration is only 13 percent greater for violet light than for blue green For visual light (\(\lambda 5100\)) the absorption is a little less; but it is seven times the differential effect which produces color excess. For the most highly reddened stars, with a color excess of 0m6, the obscuration of their visual light would exceed four magnitudesif the clouds could be cleared away they would look 50 times brighter. In the Milky Way in Sagittarius, even the bught cloud, where the color excess E is 0.10, loses half its light by passage through the obscuring veil between it and us This may not really be a star cloud at all-only a region seen through a "window" On the edge of the dark area, E = 0.4, only 4 percent of the light gets through

THE absorption has to be considered in calculating the true brightness of these stars. Allowing for it (on a basis of the observed color excess) Stebhous and the rest conclude that the "earlier" and hotte B-stars are about 30 percent toghter than had previously been supposed. The brightest of all are the so-talled G-stars, with very sharp lines, like Rigel or Alpha Cygni, which come out 12,000 times as bright as the Sun

Allowing for the absorption, our authors calculate that the most heavily obscured stars in Sagittarius are at dis tances of 1200 and 1500 light-years. In the bright cloud, we can see through the "window" as far as 3500 light-years and probably to fainter stars beyond In the opposite part of the sky, the situ ation is curious. Stars at moderate distances, not exceeding 2000 light-years show a reddening of 0.3, correspond ing to an obscuration of 85 percent of their light. But stars with the same spectrum and much fainter, are no redder. It looks as if the absorbing clouds stopped at about 2000 light-years distance, and space beyond, up to 6000 light-years, was practically clear

This is a powerful method of investigation. It has been carried about to the limit for the moment, because the spectra of the fainter and more datant stars have not yet been catalogued. It will be of important service in the great task of mapping the observable portionof the Galaxy—in distance as well a direction—and also the obscuring barriers that prevent us from seeing farther. —Princeton, November 6, 1930.

Our Superior Modernized 75's

Modernization of three game costs 18000 each a compared with the \$25,000-cost of manufacturing one 105-millimeter howitzer, toward the use of which there is now a definite trend in the accompanying article, Colonel Brane says, simply, we have "a very large supply of the old 15's on hand An other authority and recently with great quantities of such to supply a needle army in the held, -The Kelley.

N the early days of World War I. newspapers and magazines gave colorful reports of the startling successes achieved by the German Army in their rapid march through Belgium and France toward Paris These accounts told of the great destructive power of the German guns and howitzers. The world was introduced to the new Ger man heavy howitzers which quickly accomplished the destruction of the fortifications at Liege, Belgium Of all the belligerents involved in World War I only the German Army was adequately equipped initially with all the necessary types and calibers of artillery The French and British lacked artillery and were particularly deficient in heavy types The great destructive power of the German artillery can be gleaned from statistics of casualties. These statistics record that the German armies produced nearly twice as many as the allied forces and this was due, in great part, to the predominant power of the German artillery

It was during these days of the World War that Americans first began to hear about the French 75mm gun, known as the "Soixante quinze". It is scarcely an exaggeration to say that this gun stemmed the on-rush of the German

Beleased for publication by the Chief of Ordnance U S Army Statements and opinions are to be understood as individual expressions of their author and not those of the Ordnance Department Re-Construction of Our Large Stocks of Wartime 75mm Guns Would Give Them Longer Range, High Elevation, Wide Traverse . . . Work is Inexpensive

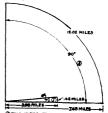
By G. M. BARNES

armies in the early days of the war, pre-

The French 75mm gun had been developed secretly and adopted in the year 1897 Its construction was a military secret which was successfully kept from the Germans Contrary to popular be hef, the great importance of this gun did not lie so much in its superiority as a piece of artillery, as in the fact that the French had an adequate supply of this one caliber. It was, however u very excellent division gun of great re hability. The secret feature was the hydro-pneumatic recuperator which gave the gun stability and smoothness in firing In this respect, it was superior to the German 77mm field gun

At the time the United States entered the World War in 1917, it became known for the first time to the American people that our Army possessed but 900 pieces of mobile artillery of all calibers. This number did not include the splendid permanently emplaced seacoast artillery which had been provided for the defense of our country against naval attack General Crozier, then Chief of Ord nance, and other Ordnance officers, had pleaded with Congress for years to pro vide an adequate supply of mobile ar tillery for the army, but prior to 1917 there was little interest in this subject When the United States entered the war, our troops were equipped with a few 3-inch field guns, model 1902 This was an excellent piece of artillery and when tested by experts in comparison with the French 75mm, was held to be the equal, if not the superior of the French gun In addition, a new type of American field gun known as model 1916 had just been tested at the Sandy Hook Proving Ground. It outranged the French gun and also had greater lateral traverse. At that time, the French, having been in the war for about three years, were manufacturing large numbers of 75mm guns and were in a position to sell to the American Government the number required for arming our troops as they arrived in France. Furthermore, as we were to co-operate with the French, there would be an important advantage in using the same caliber of ammunition which could be interchangeable The British Army went to France with their 18-pounder field gun and were consequently not able to exchange ammunition with the French The important decision was made in June 1917-and it appears now that this was a very wise decision-to abandon our 3 inch field piece, to manu facture a few model 1916 guns recham bered for French ammunition; but to manufacture mainly the French 75mm held gun and ammunition in this coun try, in addition to procuring an initial stock of guns and ammunition from the French Government As a result of this action, the close of the World War found this country in possession of a very large supply of 75mm French guns

AFTER the Armistic, studies were A made by Boards of Artillery and Ordnance Officers of the artillery lessons of the war. The consensus was that a longer range field gun should be developed for use in the next war. Consequently, several years of research and development ensued during which a number of models of guns and gun carriages were manufactured. Some of these model 75mm guns were found to be most excellent and greatly superior in range to the famous French 75mm



Prile of Park - 78 MM PREMON SUM Prile of Park - 78 MM ON HEW W.S. CAMPAS Range, elevation, and traverse of old and new 75mm gams compared

gun However, realizing the large stocks of 75mm guns available in the country, Ordnance officers could not refrain from casting backward glainces at this important stock of artillery and wondering if ways and means could not be found whereby these guns could be nutized.

The first step in this direction was to remove the wooden wheels from the 75mm gun carriage and to replace them with rubber tired wheels having roller bearings at the axles. The carriage was thus high speeded and converted from a horse-drawn vehicle, capable of travel ing at a maximum of 15 miles per hour into an artillery unit which could be drawn by a truck at speeds of 40 to 50 miles per hour. One type of modification was successfully worked out by the Ordnance Department, and another along the same line, known as the Martin-Parry Adapter, was found equally satisfactory A considerable

number of the latter units were manufactured by the Martin-Parry Compans and placed in service

While this modification permitted the gun carriage to be drawn at high speeds it was only a partial answer to the problem, since the range and horizontal traverse of the gun had not been increased. The next step was to build a complete new carriage for

the 75mm gun utilizing both

the gun and its bydro-pneumate recuprator vision. In this design, use was made of commercial developments in electric welding and the gun carrier parts were fabricated of welded allow steel plates, replacing the former type of construction which consisted of steel castings and riveted plate section. The new carriage was made of the so-called split trail type permitting the gun to be



Somewhere in France during the World War Americans manning a French 75. The gun has just been fired and shell (ase in the air is being thrown aside



The carriage was high-speeded in this first modernization step. Split trail not yet added

cli stard between two trails and allowing as high angle of traverse of the gun at the same time as mercand from 6 degrees, been time was mercand from 6 degrees, permitted by the French carriage, to 90 degrees, obtainable with the splittrail carriage. An idea of the mercane many and traverse of the new weapon on 6 und can be guined by reference to the accompanying drawing.

In this recital of the improvement which had been taking place in the criage for the field gun, the concurrent development in the ammunition for this gun has not been mentioned A stated, one of the requirements set by artiller officers for a future 75mm gun was a longer range. The general belief was that a range of about 12,000 yards would be all sufficient for a gun of this caliber, firing a 15-point projectic Still longer ranges could be obtained preferably by the use of theaver calibers of artillery. The range of the French 75mm gun, as



The 75mm gun on its new carriage -- elevation 45 degrees; traverse 90 degrees, range over 13,000 yards



The gun, as modernized, is an excellent anti-tank weapon because its traverse of 90 degrees permits point-blank or distance fire over a wide fan-shaped area

used during the World War was approximately 7000 yards. Through a combination of changes in the design of the carriage permitting 45 degree elevation and by the improvement of the ballistic shape of the projectile, this range has been increased to over 13,000 yards The design of the projectile has been refined by giving a better streamlined shape, and the resistance of the projectile in passing through the air has been greatly decreased Thus, at a very small cost, it has been possible to convert our stocks of 75mm guns remaining from the last war into new weapons fulfilling all the service requirements for a modern division gun

THE mission of held artillery is to assist the other arms particularly the infantry and cavality, in combat by fire power. In carrying out this mission the division gun is used to produce maintypes of fire destructive fire to render the target useless, neutralization fire for the purpose of lowering the fighting efficiency of the enemy personnel by in fireting severe losses concentration fire by means of which a concentration with the various kinds of barrages, such as the various kinds of barrages, such as the standing box and rolling types.

In recent years a new target requiring another kind of fire has appeared upon the modern battlefield -the high speed tank Most modern armies are now equipped with tanks capable of moving across country at high rates of speed, and are prepared to use these tanks in making mass attacks against opposing forces Tanks now have been developed to the point where machine guns and other hand-carried weapons are no longer effective against them Weapons of special design, such as the 37mm anti-tank gun, are required to penetrate tank armor When tanks are used in large numbers there will usually be a

definence of antitank guns to meet these mass attacks. Consequently very available weapon must be utilized to assist in stopping them. The 75mm gun on its new carriage forms a very effective anti-tank weapon.

It will be appreciated that the French 75mm gun carriage with its limited traverse of 6 degrees could not have been employed for firing at a tank travel ling across country at 15 to 20 miles per hour. It would have been impossible to shift the trail of the gun from one position to another rapidly enough to follow the movements of the target. The new gun carriage with its traverse of 90 de grees makes possible a type of fire with the 75mm gun not heretofore obtainable The drawing shows the great field of fire which can be effectively covered with the 75mm gun. Artiflery in most situa tions, would be emplaced some distance behind the position of the 37mm anti tank guns. But assuming that the tank attack should pass the line held by the anti-tank guns, the ability to bring rapid, effective fire upon high-speed tanks with the 75mm gun greatly enhances the value of this weapon in modern warfare.

To make this discussion of the division gun more complete, it should be stated that most armies, including our own, are now adding another division weapon to supplement the fire of the 75mm field gun-the 105mm howitzei The advantages of the howitzer are principally increased weight of pro sectile-double that of the gun projectile, giving at the same time the almost equivalent range of 12,000 yards for ap proximately the same weight of weapon. and the further advantage of a plunging type of fire As the enemy usually seeks concralment behind slopes and hills, the howitzer, through its curved-trajectory projectile, can bring more effective fire to bear than a flat trajectory gun. While it may be said that the trend in division artillery is toward the use of more 105mm howitzers, the new battlefield requirement for use of division guns as anti-tank weapons assures the gun of an important new role on the battlefield of today.

Science and modern engineering have thus made possible conversion of our large and valuable stock of 75mm guns into modern division guns. These new weapons will meet all service requirements as to power and mobility. Through re-design the gun has become an anti-tank weapon of first unportance. These 75mm guns, augmented by powertid 105mm howitzers, will provide for the American Army artillery second to none.

M followed Barnes' article is southy may person in our in discrete that we have no me in the hole to help care of would be negative to the form "are." how even discounted to me returned to me readers. Soon to the explained to our readers. Soon to come, for example, it is noticle by Acting Secretary of the Nort Charles A Edison on the power plants of the new destroyers Another will be on takes and draw mechanisation in general Look for them.—The Edison



Trucks may be used, and frequently will be during wartime, to tow the gun on its split-trail carriage at high rates of speed to its position in the line



In this air conditioned, scientifically lighted plant are 700 workers, and offices and engineering departments

Controlled Comfort For Workers

THE world's first designed windowless factory, in which working con ditions are constant and unchanging the year 'round, is in operation in Fitchburg. Massachusetts Lighting was scientifically designed to give optimum visibility at all tasks, air conditioning provides the highest degree of physical comfort for workers, exhaust fans and ducts carry away dusts and heat of all operations, and color plays an important part in maintaining worker morale and promoting efficiency. The plant is that of the Simonds Saw and Steel Company, and was designed, built, and in stalled by The Austin Company It was begun in 1931 but held up during intervening years because of the depression

The Smoods company has concentrated in this five-acre room all the operations formerly carried on in three old plants totalling 17½ acres. These include everything from forging and heat-treating of steel to the sharpening and shipping of saws machine knives, files, and other cutting tools.

The blanket of "cold" light, which is laid over everything by the more than 1400-100-watt fluorescent tubes, never varies, assures each employee absolute uni-



Manufactured "north light" is supplied where it is most needed in the great partitionless factory room



Eight self-contained production lines, each with a complete sequence of heat-treating to finishing facilities, function smoothly in the five-acre room

formity of light at this job at all times. The atmosphere inside the plant is kept clean.cool, and comfortable despite the presence of some 70 heat-treating furnaces and more than a thousand individual motor-driven granders, cutters, and other machines which are in almost constant operation and throwing off heat, dust, and smoke

Five changes of air per hour are prosided by large air-conditioning units which circulate 400,000 cubic feet of air per minute through 3000 feet of overhead ducts

Special foundations and shock and shock and sound-absorbing insulation insolate the noise and subration of four big dropping insulation inhalmers as well as dampening other hammers as well as dampening other voices in the officers. All machines are resulted a bright yellow, all furnaces and benches are painted with aluminum, all steel columns, starts, walking was, and the central grade and the starts, walking the columns of the starts of the star

ELECTRONS DANCE THE RHUMBA

D OWN the lower side of a cigarshaped radio beam, an airplane flown by Capt Milton M Murphy and Jack Haynes, Civil Aeronautics Authority inspector, glided repeatedly to safe landings on East Boston airport in Massachusetts recently These flights demonstrated for the first time a prac-

tical application of the klystron, an invention developed by scientists at Stanford University which generates ultra-short radio waves that can be directed as a searchlight directs a beam of light. The radio waves are sent out from a copper antenna which has only the thickness of a match and is but four inches long

The klystron, which promises to revolutionize certain phases of, and to bring greater safety to, an plane operation, is an ultra short-wave, ultra high-frequency radio generator Radio experts have called it "the most important ad vance in radio since Lee

De Forest invented the audion tube in 1908"

in 1908."

Already, in the laboratory and on the airport, the klystron has demonstrated its ability to produce waves of a strength interior unattainable in high frequency apparatus, waves which are only one tenth as long as any previously used. These waves may be focused and the rected along an almost straight line, and pulots receiving them are not confused by a jumble of signals from several sources.

THF stors of how the klystron was created, what it is, and how it operates at frequencies almost hevond comprehension involves a Pan American Airways pilot, a television engineer, and a professor of physics.

Some time ago. William W. Hannen, Stanford University physicsels, was attempting to develop a new kind of atom smasher. Instead of the usual type coll-and-condenser resonator he devised a method whereby radio waves could be made to surge back and forth within a copper tank. Because the rhythmic surging reminded a laboratory assistant of the rhumba, the little copper tank was dubbed the "humbatron".

Scarcely had the physicist announced this device when Flight Captain Sigurd Klystron, Generator of Powerful Ultra High-Frequency Radio Waves . . . Useful in Blind Landing System for Planes . . . Other Possibilities

By ANDREW R. BOONE



Sigurd Varian, one of the inventors of the klystron, adjusting one of the two rhumba trons that produce ultra high-frequency waves

Varian, who for eight wears had been plotting fast land planes were Mexico and Central America, heard of it. While bucking storms over Panama and Guatmeds, Varian realized avaiton's greatest needs were for a successful blimd land ing system and for an absolute terrain clearance altimeter. Ultra-high electroal frequencies, liet hughls, held the

secret. Perhaps the rhumbatron was the

Shortly Varian and his brother, Russell, who had been doing research on television, became research associates at Stanford Russell supplied ideas, Sig. and tried to work them out. One big problem was how to supply energy to the thumbatrons at the very high frequen cies needed. After many ideas that had to be abandoned. Russell finally thought of a simple way to excite the rhumbatron circuit and a working model was built Professor David I. Webster, exec. utive head of the physics department. became interested and, among other things worked out the mathematical theory of the process Soon a design was evolved for the klystron-a highpower generator using two rhumbatrons -models were built, and the invention was ready to be shown to the world

What had the inventors created?

The klystron ultra high-frequency generator utilizes the fact that an elec tric field inside a rhumbatron can be made to influence the speed of electrons. In operation a cathode emits a continuous stream of electrons. Surging for ward under the impetus of 3000 volts, these speed through the first rhumbatron.



Russell H. Varian (left) and Prof. W. W. Hansen, conducting tests with one of the complete assemblies of two rhumbatrons sealed within an evacuated casing

at nearly 20,000 miles a second. This rhumbatron causes the speed of some electrons to increase slightly, forces others to slow down, while intermediate electrons race forward with unchanged speed Leaving the first rhumbatron, known as the "buncher." the electrons speed down a short copper tube, and by the time they reach the second rhumbatron, called the "catcher." the faster electrons have caught up with the slower electrons preceding them, to form bunches The bunches successively pass through the catcher at a frequency of three billion cycles per second, or even more Through delicate synchronization of the buncher and catcher, the bunches are timed to go against an alternating current field within the catcher. This resistance causes the electrons to lose their energy of motion which instantly becomes converted into high-frequency electrical energy. Thence this energy flows to the tiny antenna

O NLY when the two rhumbatrons are synchronized will the pulsing electrons produce power. Tuning is accomplished by turning a microniter scree which adjusts the distance between two grids through which the bunched electrons flow.

Recently I observed, while visiting the Stanford physics laboratories, a start ling demonstration of this machine's nower One by one Professor Hunery brought several types of lamps into the hearn. Seven ordinary 60 watt globes to which short receiving antennas had been soldered, glowed bulliantly when brought near the reed-like mast "This he pointed out, "will give you an idea of the amount of power produced " Two fluorescent lamps were held near the antenna, one parallel and the other at a sharp angle. The former remained unlighted, while the second gave out brilhant light, demonstrating graphically the wave's polarization Again, Hansen held a filament light in position, and

the filament glowed in alternate four inch sections. Here I saw the standing wave patterns, each light and dark space representing one quarter of a wavelength.

This was, of course, a laboratory display. The tests at East Boston served as proof of the pudding. During these flights, the same antenna flashed the signals that guided the airplane earthward. It was a sort of preview of more startling innovations to come.

Other scientists enter the picture here. Irving R. Metcalf, head of the Civil Aeronautics' Authority technical



Ultra high-frequencies are transmitted from the tiny antenna projecting through the disk. Antenna length is adjusted by sliding the copper tube on the rod

division had evolved an idea for improving blind landings. He laid the problem before Professor Edward I. Bowles, Massachusetts. Institute of Technology electrical engineer. As a result, a system was developed which involved transmission of two radio waves from the sameshot.

The system however, possessed too little power, so the eastern experiment ers called upon the western inventors for help. A klystron, built at Stanford by I. R. Woodyard, a graduate student, was flown east to Boston. At the East Roston arroom it was connected to an ingenious horn invented by Professor W. I. Barrow, another M. I. T. electrical engineer. This device made possible the transmission of a highly directional beam of radiation. The beam's characteristics can be explained this way. As the radio waves leave the horn. they lose intensity, in accordance with well known laws. At any particular distance from the source the greatest in tensity will be found on the axis of the beam. Now the pilot's blind landing instruments are adjusted to indicate to



Laboratory model of the wave-directing horn described in the text. To this horn has been adapted the klystron high-frequency generator

him a path of equal wave intensity Thus, if one thinks of the pilot as being on the beam axis at a point, say, 500 vards from the radio source, then in order to follow, by his instruments, the path along which the radio intensity will remain the same as at that point, he must drop below the axis and follow a slightly curved path, since obviously the equal intensity path must depart from the axis. The shape of this path may be thought of as like that of the surface of a cigar Advantage of the path created by offreshort waves is that its curvature permits the pilot to glide fairly evenly to the ground

In the future, Sigurd Varian believes,
"sandwich" landings will be feasible,
in which the plot glides down a straightline path along which the signals from
two beams are equal. He thus will be
"sandwiched" between the upper and
lower beams emerging from two horns,
one titled higher than the other. So preces will be the path formed by the two
beams that the pilot will need only to
start down at a safe rate of descent and
by consulting three hights on his instrument panel whose flashes signal his position (a device invented by Metcalf)
keep to his abdung course

Here, radio engineers believe, science has developed a radio searchlight, which opens the way to greater safety not only in the air, but also on the sea. By throwing the beam in any desired direction, many useful things can be done

Other possibilities lie in new directions. The klystron's ability to produce short waves may make it possible for a million people to talk simultaneously through a single circuit. Operating on very high frequencies, hundreds of television channels can broadcast pictures and sound, where today one channel is available. Surging electrons, breaking like waves on a beach, have opened many fields which engineers will conquer as time goes on

THE PITTSBURGH of Old Palestine

American Archeological Excavations at an Arm of the Red Sea Bring to Light a Buried City with a Smelter in which King Solomon Refined his Copper

By NELSON GLUECK

REAT commercial enterprises were w bound up in ancient times with the spices of Sheba and the gold Solomon was the first-and the last-king in Jerusalem, who not only benefited from the overland trade route to Arabia, but also took full ad vantage of the sea route from Eziongeber to Ophir

"King Solomon made a fleet of ships in Ezion-geber, which is beside Eloth on the shore of the Red Sea in the land of Edom Once in three years the fleet came in, bringing gold, silver, ivory, apes, peacocks a very great amount of sandalwood, and precious stones' Kings 9 26. 10 22.11)

Enterprising entrepreneur that Solo mon was, his shipping line evidently made such inroads in the lucrative caravan trade that had probably been largely in the hands of the Oueen of Sheba, that she hastened to Jerusalem with all manner of presents in order to conclude an amicable

trade agreement with him

"Now when the Oueen of Sheba heard of the fame of she came to Jerusalem with a very great retinue, with camels bearing spices and very much gold and precious stones. As soon as she came to Solomon she told him all that was on her mind, and Solomon answered all of her questions Then she gave the king one hundred and twenty talents of gold, and a very great quantity of spices and precious stones Kings 10 1,2,10)

A satisfactory commercial treaty was evidently negotiated between the two sovereigns, because we are informed that "King Solomon gave to the Queen of Sheba all that it pleased her to ask, besides what he gave her according to

his royal bounty (1 Kings 10 13) The pro Arabian policy of Solomon was all the more natural in view of the fact that along the eastern border of his kingdom lay great deposits of copper and iron. They yielded the commodities he could exchange for the spices of Sheba and the gold of Ophir A long part of the trade route between Arabia and Palestine traversed this border stretch of land known today by its ancient name the Arabah. It is a great rift extending between the southern end of the Dead Sea and the Gulf of Agabah. as the northeastern arm of the Red Sea is now called. It separates the territory of southern Transjordan from that of southern Palestine and marked anciently the dividing line between Judah to the west and Edom to the east. The archeological survey expeditions of the American Schools of Oriental Research Jerusalem and Baghdad, have mapped a long line of copper-and iron-mining and smelting sites in the Arabah, extending from near its north end all the way to the Gulf of Aqabah The presence of most of these sites was previously unknown They are marked by large slag heaps, the ruins of miners' huts and smelting furnaces, and great walled compounds in which the slave laborers were lodged and guarded. The pottery remains indicate indubitably that the period of main activity in these mining camps coincides with the reign of Solomon in the 10th Century B.C. These discoveries cast a new light on Deuteronomy 889, in which the Promised Land is described as "a land of olive oil and honey, a land where you may eat bread without scarceness lacking nothing, a land | in this instance the Arabah | whose stones are non and out of whose hills you can dig copper

EXCAVATIONS conducted in the spring of 1938 and again in the spring of 1939 by the American School of Oriental Research Jerusalem, under the direction of the writer, at Tell el Kheleifeh near Agabah, have resulted in uncovering part of the buried city of Ezion-geber, which served as King Solo mon's naval base. The location of Ezion geber was conditioned by a num ber of factors. At first glance one wonders what induced the original builders to choose the particular site they did, because it is about the most uninviting one along the entire shore of the northern end of the Gulf of Agabab. Situated in the bottom of a curve which is banked on the east side by the hills of Edom which continue into Arabia and on the west side by the hills of Palestine which continue into Sinai, Ezion-geber is open to the full



The site of Ezion-geber, known today as Tell el-Kheleifeh, before the excavations began

fury of the winds and sandstorms from the north that blow down the center of the Arabah as if driven by a draft forced through a wind tinnel

The site of Ezion-geber is somewhat more than 500 yards removed from the gulf, and is about half way between Aqabah in Transjordan, and Mrashrash in Palestine. It is not difficult to understand why Ezion-geber could not have been built farther to the west From Mrashrash to the site of Ezion-geber, there is no sweet water obtainable in a distance of some three miles for drinking purposes. The point where the sweet water wells begin is marked almost exactly by the location of the ruins of Ezion geber From there eastward. there is a continuous line of such wells, increasing in number the closer one gets to Aqabah, and marked by a

correspondingly increasing number of date palm trees between the two points While one realizes, then, why the early builders of Ezion-gebei could not very well have built farther to the west, one wonders at first why they did not build



Showing the precise location of the site of ancient Exponseber

farther to the east, nearer to Aqabah, where there is more water some water some to where there is some water unde and the and-storms that blow forcely and frequentially, especially along the line of the location of Euion-geber, in the centre of the southern end of the Arabah. The actual to the conference of the Arabah and the analysis of the cut of the Arabah and the Arabah and

The excavations were for various reasons begun at the northwest end of the mound, not the least of them being consideration for the direction of the winds. It was found that all the houses were made of mud brick. A large mud brick building with ten rooms was opened up, which occupred the entire



A section of the excavations at Ezion-geber showing ancient walls and modern workmen

northwest corner of the mound. It soon became evident that this was not an ordinary large building or palace but a completely novel type of structure, the like of which had not previously been discovered in the entire ancient Near East The walls of the rooms were pierced with two rows of flues and the main walls were interconnected by a system of air channels inside the walls, into which the upper rows of flues opened. The spaces between the two rows of flues had been turned green by reason of the sulfurous gases to which they had been exposed. The originally unfired yellowish mud bricks had been baked by the heat of the fires in the rooms to the consistency of kiln-fired bricks Masses of hard baked clay debris on which the pottery crucibles

had been placed, completed the picture It became evident that the building was an elaborate refinery, where previously roasted ores were worked up into ingots of purer metal. It was obvious both from the sulfuric discoloration of the walls, the fragments of raw ore found, and the numerous finished articles discovered in the site, that the refinery at Ezion-geber was devoted largely to copper, of which great quantities abound in the immediate vicinity and along most of the length of the Arabah, and in adjacent Sinai. A long period of mining and smelting and refining must have preceded the construction of the elaborate refinery at Eziongeber The Kenites who were native to the country, and whose very name indicates that they were smiths, and the related Kenizzites who were also smiths by profession, were in all probability the ones who introduced the Israelites and the Edomites to the arts of mining and metallurgy It will be recalled that Moses took a wife from the Kenttes, and that the Israchies, ever afterward manitained the closest relationship with them. The Fdomities, too, were related to the Kenttes, through the Kentzzites. The Babble Tells use that Tubal Cam (a Kentte) was the first forget of copper and from instruments and that the henizates lived in the Valley of the Kentzites lived in the Valley of the Arabah with its long line of copper mining and smelling sites.

E ZION GEBER was thus more than a scapert. It was primarily a great industrial center. The second season's excavations revealed the presence of additional similar smelting and refining plants. The reason, then, why the original builders of Ezion-geber chose the inclement site they did for the location of their city, was because they wanted the strong winds blowing from a known direction to furnish the draft for the furnace rooms in the refineries and to enable them to dispense with an expensive and burdensome bellows sys tem It was a matter of harnessing the elements for industrial purposes. More important to them than much water for fine palm groves, and protection from sandstorms in a location farther to the east, were strong winds which would enable them to operate without a handbellows system, the refinery with its intricate system of flues and air channels That Solomon built this great industrial and shipping center has been proved by the discovery of a very strong three doored gateway, similar to the one he built at Megiddo, and almost exactly the same as the one built by him at Lachish

Solomon's copper and shipping interests, coupled with his rôle as importer of spices and other precious products from Araba, do not by any means exhaust the last of his major activaties of commercial importance. As a result of all his immensely successful undertakings, the comparatively little kingdom he ruled over became a first-rate power among the nations in the ancient Near East. Its importance was altogether out of proportion to its size Hardly had Solomon established himself firmly on the throne than he embarked upon a great system of public works which extended throughout the length and Dreadth of the langth and Dreadth of the length and Dreadth of the langth.

THE resplendent temple in Jerusalem was built, also a new palace, and fortifications for the city Key fortresses were erected or strengthened throughout the country, store cities set up to pre serve great supplies for emergencies huge barracks to house his large standing army, and great stables for his chariots and the horses of his cavalry regiments, the figure of whose personnel is given as twelve thousand Excavations at Megiddo have revealed the stablewhich were constructed there for Solomon, complete with rows of stalland stone mangers and stone hitching posts. To carry out his building program. Solomon did not even hesitate to draft thousands of his own subjects into compulsory labor battalions "And this is the reason of the levy which King Solomon raised, in order to build the House of the Lord, and his own palace. and Millo, and the wall of Jerusalem, and Hazor and Megiddo, and Gezer . And Solomon built Beth-horon



Sifting the debris to find the smallest objects it might contain

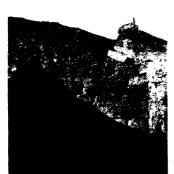
and Baalath, and Tadmor in the wilder ness, and all the cities of store, and cities for his chariots, and cities for his horsemen. Solomon had forty thousand stalls of horses for his chariots, and twilve thousand horsemen." (I Kings-915-19, 126, 527-28).

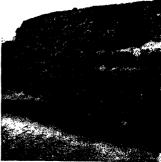
All the stables which Solomon had constructed were not however, intended solels for his army's horses. Solomon was in the literal sense of the word a horse trader. He was also a dealer in chariots. "And Solomon had horse brought out of Egypt, the king's traders receiving them at a price. A chariot could be imported from Egypt for six hundred and fifty shiekels of silver, and a horse for a hundred and fifty. Thus through their means trade was carried on with all of the kings of the Hintitte-

and the kings of the Aramaeans." (I Kings 10.28-29).

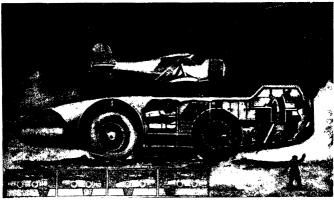
It is understandable, then, in view of all of Solomon's industrial and commercial activities, that there was a remarkable economic development in Israel during his reign. He established himself as the great middleman for the overland trade between Egypt and Arabia on the one hand, and the Hittitte and Aramaean kingdoms to the north of his territory on the other. For much of his imports he must have paid with the copper extracted from his mines in the Arabah and refined at Ezion-geber. There is indeed a basis in fact for the Biblical accounts about the fabulous wealth of Solomon weight of gold that came to Solomon in a single year was six hundred and sixty six talents of gold, besides that which came from the traffic of the merchants and from all the kings of Arabia, and from the governors of the land The king made silver in Jerusalem acommon as stone, and he made cedars as plentiful as the sycamore trees that are in the foot hills " (I Kings 10 14 15 27)

A Though was has alreads limited the field excavations of the archeologists—the "digs," as they call them among themselves—this magazine will endeavor to present articles about significant digs if the was leaves one man to dig and one more to read Fortinatele, when was cramps the archeologists work he still can work by material he has dig up while the digging was good and stored away.—The Editor of the digging was good and stored away.—The Editor.





Inside and outside views of the south wall of the ancient copper refinery, showing the open ends of a number of the flues. The old mnd bricks were found to have been fired to the hardness of kiln-fired bricks by the hot blasts of ald



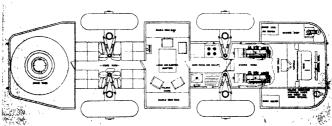
will go to the South Pole Insets show Cruiser crossing a 15 foot crevasse. The front wheels are retracted, the body slides across, then rear wheels are retracted and front wheels lowered to driving position

The Snow Cruiser, A Mobile Base For Antarctica

W/HEN the government-sponsored South Pole Expedition commanded by Admiral Byrd arrives in the Antarctic sometime this winter, it will have a unique vehicle which will be used as a mobile base. Designed by Dr. Thomas C Poulter, it looks like a cross between a huge bus and a military tank It is so constructed that it can negotiate rough ice fields, cross crevasses up to 15 feet wide, will make speeds up to 25 miles an hour, and have a cruising range of between 5000 and 6000 miles

The craft will be 55 feet long and 15 feet wide, and will carry on its roof a five-passenger airplane. Its cost will be \$150,000, its weight 75,000 pounds, and its body will be completely are welded and so insulated that the crew may keep warm when the temperature outside is 100 degrees below zero. Inside will be a control room, engine room, galley, living quarters for four men, a store room and cargo space. The pneumatic tires will each weigh close to 1500 pounds Hydraulic control of each axle permits the Snow Cruiser to "lift its own foot" so that a roof derrick may be used to change tires. A special device in each wheel keeps the air pressure constant by pumping in or releasing air as need The adjustable mounting of the wheels permits retraction of some wheels to allow the vehicle to slide over obstacles Each wheel will be independently driven by a 75-horsepower motor, all being powered by two gener ators driven by two 150 horsepower Diesel engines

The expedition will confirm the claim of the United States to a strip of land some 600 miles wide in the Antarctic and it is expected that the Snow Cruisei will drive straight to the South Pole and remain there for a number of months



Plan view of the unique vehicle which rolls or slides. Here are shown control cabin, chart room, bunks, galley, engines, store room. Note independent mounting of separately controlled wheels. Fuel tanks are along center line under floor



Conducted by F. D. McHUGH

VERSATILE EYE-TESTING MACHINE

MORE occurate and specifier reveals of the canonism are made possible by the development of a remarkable reveteting instrument capable of placing an infinite number of different lens combinations before the eyes. In actual figures, the batteries of lenses contained in the device permit the amazing total of 61,000-308,816 different prescriptions, ac ording to Dr. J. F. Nemmeller, director of American Optical Company is bureau of svisual science, who amonomed recently a new model of the instrument, far superior to the original developed a few years ago.

For many years prescriptions for glassiswere arrived at by inserting different lens combinations into a spectacle frame held before the eyes. This was done by hand and the procedure to obtain an accurate prescription was slow, awkward, and often maccurate

The an attempt to speed up the eye examnation and make it accurate, the Additive Phioroptor was developed. The instrument contains batteries of rest lenses, to manapating dials and knobs, different lens containing dials and knobs, different lens containing dials and knobs, different lens conwith according rapidos. An ingenious mechanism suitant the instrument automatically adds the individual lens powers and records the total correction on an indicator. From this reading, glasses are then made up.

ade up The design of the instrument - lens sys



The Additive Phoroptor in Use

Contributing Editor

In charge, Daniel Guggenheim School of Aeronautics, New York University



Rear view of the Phoroptor showing lenses used in the instrument

tem involved a mammoth task of mathematical computations, Dr. Neumueller stated, as not only the lens curvatures and thickness, and the distance between the lenses, but also the position of the lens system before the patient's eyes had to be controlled to assure the accuracy of prescriptions for files.

IMPROVED WHITE

LEAD

MPROVED manufacturing technique in the production of white lead has resulted in three interesting developments which are important to the paint user. The light-reflective quality of white lead has been increased from approximately 81 per cent to about 90 percent and this results in an economy in the amount of artificial lighting necessary in the average home or office Pure magnessum oxide, the whitest sub stance known and therefore the one used as a basis of comparison in photometric tests, reflects only about 7 percent more white light than does white lead Light reflective qualities of paints which differ in their intensity by only a few degrees are not observable by the ordinary layman but, nevertheless, do bring about an appreciable economy

Still another improvement due to the new manufacturing technique has been an in crease of almost 23 percent in hiding, or

covering, power which while again not noticeable to any but the technician, does obviously create an advantage in making possible more economical painting, fewer gallons are required to cover a given area of surface

of surface.

A third development has been an increase in paint thickening properties, or bodying power, of white lead which decreases the tendrices of the paint to run and sag during application and hiner allows for greater brushing quality. C. F. Greeres-Carpenter.

INSTRUMENT REGULATES LOCOMOTIVE CUT-OFF

O.O. valve. Polot developed to the Valve Polot Geoperation. The Valve Polot Geoperation, is guiting the theory of locomotive cut-off regulation into scientific practice. As steam engine accinct has long known, a certain quantity of steam, allowed to expound in its natural way, will accomplish the same result for the job at engineer's trick is to use the minimum amount necessary. This is referred to a cut-off, or firing the steam supply to the



Location of the Loco Valve Pilot in the cab of a steam locomotive

cylinders at a certain point for maximum economy and efficiency

To reach this goal, the Loco Vaive Pilot is first a spredometer which functions in the usual way On the same dist which shows speed, another pointer gives the correct cut-off for each variation in speed Where, for merly, an engineer could only estimate his speed by counting mileposis or guessing, the now has an accurate speedometer. Then, in stead of leaning out of his each, hatening to

the puffing sound from the smokestack and approximating the cut-off accordingly, he gets instantly and continuously all the nec essary information from the instrument

The device includes a recording instrument supplied with a roll of paper on which there is charted a record of the speed and cut-off during the entire trip. At the end of the run, the supervisor of operations has a written record showing how well the engeneer handled his engine, so that economies in fuel and time may be calculated

The motion of the locomotive is used as power for working the instrument. The speedometer mechanism consists of a speed until drug fitted on the engine in frictional contact with the tread of a driver wheel. From this point, a flexible chain shall leads to a centrifugal governor which actuates the speed-indicating needle and recording penetral properties of the power for moving the tape is taken also from the flexible chain driver.

The cut-off device is based on the principle of converting the motion of the reversibility to the following the reverse shaft to a cam mechanism by means of a cam operating rold This action is converted into cut-off in a cam box Finally, a calle running from the tox transmits the force to the cut-off hand and recording penul in the call.

GERMICIDAL ENERGY

METER

DEVELOPMENT of an easy and mex pensive way to measure the bacteria killing effectiveness of ultra violet from



Light meter attachment makes possible measurement of ultra-violet

germicidal lamps, has just been announced by Lighting Research Laboratory of Gen eral Electric's lamp department

Conceived by Matthew Luckiesh, world famous scientist and director of Lighting Research Laboratory and Contributing Editor to Scientific American, the method of measuring the germicidal ultra-violet makes use of the familiar GE light meta.

Over the sensitive cell of the familiar light meter there is placed a continuous consisting of an appropriate fluorescing material sandwiched between a plate of clear quartz and one of clear ordinary glass. When the quartz and of the device is toward the source of germical energy, the fluorescince is extend by both the germical energy and the energy of longer wavelengths. Light meter, when the glass side intoward the source, the short-wave germicald energy is absorbed and, therefore, does not excite fluorescine. The energy of longer not excite fluorescence. The energy of longer materials are said to the state of the said o



Towed as a trailer, the portable air compressor goes to a job

wavelengths does excite fluorescence. Obviously, the difference between the light meter readings serves as an accurate measure of the germinidal energy.

ELASTIC "GLASS"

Will the appearance of glass, with the visibility and elasticity, with reastion and the visibility and elasticity, with reastion and the visibility and elasticity and anounced may find many uses in exercised the and in industry. In its notical color it is clearly transparent, but may be made also in rich and sperkling colors such as garactic supplier, emerated amber, as well as black and white So far, no hand of the humals comprising this material nor of the process and white So farmed have four richest for publication.

At the present time this clastic "glass"; is being used for making garters, belts, and braces but the manufacturers claim that it will soon go into the manufacturer of laggage, handbage, womens belts, and many other smillar times. Sone it is gout to ough, does not stuff or crack, is odorfess, taxteless, and non toxic, probably will be adapted to the manufacture of many noveltues, and one mas veen expect to find it as a book binding, for it may be stamped in gold or in silver and will take printing

BATTLE WAGONS

THE United States has five battleships about the same age and the same general type as Britain's Royal Oak, which was sunk by torpedoes. They are the Nevada, Oklahoma, New York, Tevas, and Arkan-

PORTABLE AIR

CONTRACTORS often need compressed air for small jobs of breaking concrete or rock drilling, even though their work is not generally of a type that would permit them to maintain large and expensive compressors on jobs requiring but little air it

is often necessary to move large, and cumber some equipment to the site of the work. The Sulham Machinery Company has, therefore, designed a portable compressor, called Exph Arr, which is light in weight, unusually compact, and may be towed behind any assessing a submobile or mounted on a light trick. It is rugged and powerful, and, the amendaturers claim, is more efficient in several respects than larger machines—for one of which believes are at the rate of 66 cubic feer per minute, and the other at the rate of 85.

LINTLESS SURGICAL

SPONGE

QURECONS find a necessary to use some some frequently during all all some of special some frequently during all of uperations. Nat sponger cannot be used because stricting and boling breaks them apart. Hence, gause pads and cettoning breaks them apart. Hence, gause pads and cettoning the control of the co

A new type of sponge, just announced ladbout, is made from sotion fibers converted chemically into a regenerated form of cellulose. It will absorb 20 times it weight in water, is free of lint, and can be sternlized by boiling or ma naturchare One set has been used, sternlized, and re-used, over 30 times. They have been used for eye, tonail, and massind surgery—all operations in an open sternline of the control in an open sternline.

PROTECTING WINDOWS IN BOMBING RAIDS

SAFETY glass, such as is used in motor care today, depends upon the adherence of the glass to the glass's center layer of transparent plastic. This same principle (with variations) is being made use of, in European cities where bombing rates arismment, to prevent flying spinters of glass when windows are broken by the concussion of exploding bombs.

Wire screen, cellulose sheets, and crisscross gummed paper strips are being used for the purpose. In addition, latex as other spraced or panned on the glass spraced or panned on the glass According to India Rubber Forld, "angle sprayed to India Rubber Forld, "angle sprayed coast of latex averaging 0,004 to 0,005 of an inch in thickness on % inch glass windows were found to prevent sphintering when a two pound spherical weight was dropped on the protected glass from a distance of six feet, whereas unprotected glass shattered in all directions under the same force."

FIGHTING FOREST FIRES

THERE were enough forest fires during the year 1938 to damage 33,815,000 acres (an area almost as large as that of the state of Arkansas) with damage estimated at about \$37,000,000 Anything that can be done to reduce the number of forest frees or their effects is of national importance and the United States Forest Service is to



Special suit, head-gear, and shoes protect parachute jumper on landing

be complimented on its vision in utilizing the parachite as another protective method Experimental use of the parachute is being made in the Chelan National Forest and, while definite conclusions have not yet been drawn, the experiments are highly promising

One way of using the parachute consists of dropping fire-fighting tools, equipment and supplies needed by the fire-fighter on the ground. One carefully planned kit comprises shoved, axe, flashlight, water, rations, compass, map, first aid equipment, and perhaps a light radio set. A simple 10 by 10 foot burday chute is set.

Another method of utilizing the parachute is to drop the fire fighters themselves, after the equipment kit has been released. These men will be intensively trained and will be dropped on the "softest" spot as near the location of the fire as possible. Upon land ing, the man crawls out of his protective suit, frees himself of the parachute, retrieves his equipment pack, and strikes out for the nearby fire. I'wo or three men may be dropped on the same spot, but one good "smoke chaser" can do wonders. The protective suit is shown in one of our illustra tions. It is worn over the clothing, is padded with sponge rubber, and has a head gear fitted with a steel face mask and neck protector There are ankle supports, tough gloves, reinforcing straps and other devices



Fire-fighters' supplies ready to be dropped by parachute to ground

to protect vital spots of the body from in jury. In a streamlined pocket, a rope is provided for climbing or descending from a tree.

Another item of interest lies in the para chute itself. The special 'chute meets Army and Navy requirements and descends at the relatively low rate of 14 feet a second The new type of "lobe" 'chute is said to be safer than the more conventional type be cause it is built with an outside convex canopy resembling a collar 'round the rim, and is provided with flaps. By pulling down the shroud lines on either side and thus actuating the flap, the 'chute pilot can do a great deal to guide himself. Of course, it is quite possible to pull down on the shroud lines of the ordinary parachute not provided with flaps, but experienced jump ers consider such practice hazardous as it may cause collapse of the entire supporting surface. Another feature of the new design is the reduction of swinging to and fro of the jumper which lessens the chance of in jury by striking trees or rocks -A K

TETHERING THE

AIRPLANE

THE rapidly increasing number of priof hangar space, and ariphanes left outdoors can suffer real damage in strong winter winds Walter C Clayton, writing in Amation, points out a number of methods of "tethering down" the airplane, whereby possibilities of damage may be reduced The main principle is to reduce the lift of the

One plan is to tether the plane us a substantially hornountal position, with the tail a brittle higher than in normal flight, and to head the plane must be wind. Another proposal is to tether the airplane with the tail into the wind, so that the lift forces will actually press the airplane note the ground. A third method is that illustrated in the diagram Here apoller boards are placed over the wing. At the same, time, and will also the time will be a superior to the same time, and various parts of the airplane fastened by cables to ground anthorn—A K

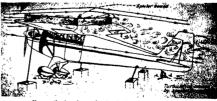
NEW IDEAS FOR AERIAL Warfare

JUST as in every war, a crop of new judgas have appeared to improve the gentle art of legalized murder. Since mod ern wars are likely to be fought mainly in the air, inventors and engineers have turned their attention mainly to divices which are concerned with acrial warfare. It is in teresting to not a few such divices.

U. A. Sanahria of the American Tele vision Institute, has developed plans for a flying torpedo often suggested yet never practically realized. The torpedo is to be s small, streamlined airplane controlled by a lurger airplane a bundred miles away The torpedo plane is to carry a load of explosives which would explode on hitting the target. In the pose of the torough plane is a television transmitter which televises the scene in front of the torpedo plane to the distant control airplane. The personnel of the control ship is then able to steer the tornedo directly onto the target by radio control Instead of subjecting costly bomb ers and well-trained personnel to antiaircraft fire, enemy centers could be at tacked by a cheap craft, with no risk to personnel. The question is (an the multuplicity of complicated devices involved be made to work under actual and practical, rather than laboratory, conditions

On the other hand, the Sperry Gyroscope Company is reported to be working on im provements to the more convintional bombing methods in bombing operations today, the officer operating the bomb aight has to inform the public how to change the course so as to give him the best shot at the target In a new electrical coordinating device, the bomber adjusts his sights, and an auto-matic pilot does the rea!

Incidentally, the accuracy of our present bomb sights is the envy of all foreign nations, and their construction is one of this



How spoiler boards are placed to hold a plane in a high wind

nation's most jealously guarded accrets.

After practice bombings by the Air Corps, the sights are always removed and placed in safe-deposit wailts. During recent months, reports have been current of direct hits on targets made with almost perfect regularity from allitudes of 25,000 feet.

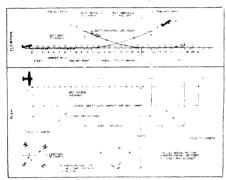
PHOTOGRAPHIC

METHOD OF MEASURING TAKE-OFF

IT is most desirable to know how an air plane makes a take-off or comes in over an obstacle, particularly when the wing loading is high The old theodolite system



Above Camera, at right, photographs plane during take-off, to check on flying efficiency Below Layout of the course on which such measurements are made



of obtaining such information depends on the skill of the observer and leads to tedious calculations. Photographic records with measurements made on films are more accurate, but cumbersome. The Materiel Division of the Army Air Corps has therefore developed a new method which is accurate yet remarkably simple.

The general addence is illustrated in one of our diagrams. The main piece of equipment is a "gan" camera, capable of taking these photographs per second, and provided with a builton stop watch. The only other equipment is an anenometre for measuring wind velocity, and large stand flags numbered from one to thirty. Reports are made separately by the camera man, anenometer operator, course observer, and arplane pilot operator, course observer, and arplane pilot.

It takes about an hour to get ready for the real As shown in the diagram, marker flags are placed at intervals of one-hundred feet on a 3000-foot course A portable camera shack is placed mid-way on the course but 1500 feet away from it. At a signal from the camera man, the test starts Continuous shots are taken from a point absed of actual take-off to the point where the airplane has reached an altitude of over 50 feet in landing, the camera picks up the airplane at an additional course of the control of the course of the course

After the strip film has been developed, it is wound on a spool and projected vetrically on chart cards. For this projection, the 3000 foot course is reduced to a scale drawing The chart shows directly, without calculations, the actual horizontal and vertical position of the airplane at any instant.

A great advantage of the simple method is that the records can be studied at lessure by pilots and technicians, and the true ground performance of the arphane really evaluated Particularly when accepting expensive new amplane, the Materiel Division will have a powerful weapon for cheeking the predicted and contracted performance. Of course, similar information is might indensitie also for private planes of the property of the

ROTARY AIRCRAFT NOTES

A SMALL helicopter, being built by Dr De Bothezat, is to weigh something in the neighborhood of 600 pounds, with a 90 horsepower air-cooled engine. The aircraft is to be provided with two superimposed airscrews, each of the controllable pitch type. The blades are to be of duralumin, besides vertical ascent and descent, a high rate of forward speed is expected. Tech is all details are searce and forthcoming flights will be awaited with great interest.

An interesting thought from a correspondent While experimentation in very advanced giro and helicopter types is entirely in order, should not other manufacturers be sides the Kellet Autogro Corporation give a little attention to getting rotary aircraft into actual production, contenting them selves with evolutionary rather than revolutionary improvement! — 4 in the production of the prod

WHY THE CURTISS HAWK IS BEATING THE MESSERSCHMIDT

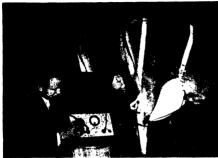
F COURSE we are all neutral, but how pleasant it is to hear that the Curtiss Hawks are out maneuvering and out-fighting the German Messerschmidt pursuits on the Western Front' So many friends have asked us the reason that, after verification in well informed quarters, we can risk the follow ing Mancuversbuity is to some extent a question of wing loading. When the wing oading is too heavy, the ship can no longer be rapidly maneuvered, and in a sharp turn the plane may stall It, the Messerschmidt. in the frantic attempt to secure high speed, the wings were given too high a loading, clipped too short. It is of course, too much to hope that German designers will not profit by the lesson! 4 K

RADIUM

AVIATION is creating an increased demand for radium salts for use on luminous instrument dials During the World War planes had a maximum of eight dials whereas today the average small plane has 12 to 15 luminous dials, and larger craft may have 60 to 75

MOLDED NON-METALLIC BEARINGS

To make molded non-metallic bearings to meet various service requirements, more than 30 formulas have been developed by the Gatke Corporation These bearings are now used in many industries as they have enormous resistance to wear, a lower



Cows are receiving the benefit of advances in medical science, as witnessed by this demonstration of a newly invented distillering machine for applying heat treatment for adhesions and other ills of the udders of cattle. Demonstration was given by Dr E. D. Hildreth, professor of bacteriology at Ohio University, at Randfeight form, Lockport, New York

coefficient of friction than metal, and are not damaged by salt water, oil, grease, or most organic solvents. They have a high impact strength and will withstand repeated shocks and blows without being permanently deformed. They are made in three general types water lubricated, oil or grease lubricated, and self-lubricated.

Depending upon the formula, these bearings may be used in many industries, including the chemical, where they must be run continually submerged in various kinds of liquids.

DRUG COMBATS SERIOUS DOG DISEASE

A NEW drug to combat the rapidly spreading heartworm infeatation of dogs will shortly be made available to veterinarians. The drug, antimonial III catechol throvalicylic acid sodium, is the result of three years of intensive research by James A Austin and Dr Harold P Brown of Kansas City, Missouri

Heartworm infestation of the dog is a unique disease because living adult worms. Directlaria minits, 8 to 12 inches long, situate themselves in the right heart. Under treatment, the adult worms are slowly killed by gradually building up a concentration of trivalent antimony in the blood stream of the dog.

The ill effect of heartworm infestation upon the host is not entirely due to the presence of the adult worms in the heart Larvax liberated into the blood stream also damage the dog. These larvae, or mero filariae, 0.2 to 0.3 millimeters in length, are worm like in appearance, and move through the blood with a whipping motion.

Heartworm infestation cannot be transmitted directly from dog to dog, but must pass through an intermediate host. The mosquito has been indicted, and the tick, flea, and other biting and sucking arthropods and insects are suspected.

Treatment of the condition involves a

series of graduated daily doses of the drug administered intravenously -- Science Series e

COLLISION SWITCH

THOUGH fires seldom follow automobile collisions, the danger is an ever-present one and a menace not only to the lives of passengers but to the cargoes of large trucks. When fires do happen they are usually



Above Collision switch in operating position. When the car is in collision, switch opens the ignition circuit, as shown at the right

caused by the automobile's ignition which cannot be turned off as can that of an arrplane when a pilot foresees a crash Thus the Grigoby Collision Switch has been designed to give a positive cut off of the ignition of cars and trucks as soon as a collision occurs.

As shown in the two accompanying illustrations, this device is relatively simple. A vertical weight rests upon a button which presses a disk in contact with two plates to complete the electrical circuit. This weight is held in place by a spring so that ordinary jars and jolis have no effect upon the setting As soon as a crash occurs, however, the excessive jar throws the weight off the button so that the disk is spring away from the plates, thus breaking the circuit completely By means of a protruding knob, the device may be reset unstantly by the driver

ANTISEPTIC RUBBER

ANTISEPTIC rubber goods — dress shields, toys, baby pants—may soon be extended to include antiseptic rubber sheet ings, surgeons' glover, rubber cases for in struments and similar trems, by the introduction of three new chemical compounds designed to render rubber fully antiseptic, according to a manufacturer.

The new materials are reported to be three, three, and six times as powerful as thymol in antiseptic qualities. They are white, odorless crystals, said to be effective in concentrations of 0.5 to 1.5 percent (depending on the rubber stock), and to contain no metallic salis.

Rubber products so treated are said to meet with the standard tests for antiseptics as set forth by the Food and Drug Admin stration.

SELF-REGISTERING

RAINFALL MEASURER

An instrument for measuring rainfall, holm Observatory, Fabran Nisson, has found widespread use in Sweden Readily portable, it works according to a new principle and is said to be ten times more sensitive than older apparatus of this kind in addition, it is capable of registering unlimited quantities of rins kind from the sensitive of the said to addition, at the contract of the said in addition, at its capable of registering unlimited quantities of rainfalls.

The ram is collected in a moverable measuring vessel, which is automatically empirical in 1/30 of a second, whereupon it is mediately functions again. The instrument is self-registering and works for a week at a time, and thus requires very little attention By means of an ingenious system, the ram which is the read exactly the amount of ram which has fallen during any day, bour, munite, and even second during the week

The instrument measures snow with the same accuracy. This is allowed to fall into a calcium chloride solution, which keeps the snow liquid even in very cold weather. The



snowfall increases the volume of the calcium chloride, and the excess runs through a siphon device to a gage where it is registered. Holger Lundbergh

TABLE LAMP

A UNIQUE table lamp, which becomes are out, has been developed for use in bedrooms to eliminate groping for the lamp, and in nurseries to reassure children who



Operating cost one cent a month

plow is not bright enough to keep light sleepers awake, or it may easily be seen one plow tube is concaded in the haze of the lamp 4s soon as the room becomes dark, the soft, warm high characterists of the neon glow tube emanates from the spherical body of the lamp, which is composed of transburent plastic. The glow tube consumes only 's, want of electricity operating cost of the control of th

ASTRONOMICAL LIGHT

DiECUT hourses of luminous paint coarded research mona, stars, comets, and some of the planets compress a noveled package rescalls put out under the name of Twinkle-Twins. Many people interested in astronomy are using these to locate light way they may be stuck to ecologies or walls where they may above the most light for activa to the may also the most light for activa to the manufacturer claims that they also show for an hour after each activation.

SPOT-WELDING THE

RETINA

ELECTRICAL spot welding in the eye for restoring sight to patients threat-ened with blindness due to a detached retina is helping more than one out of three patients, Dr. Samuel J. Meyer, of Chicago, recently reported to the American College of Surgeons.

The retina is the light-sensitive part of the eye which transmits images to the brain through the optic nerve. It may be compared with the photographic film or plate in a camer, It depends for its nourablement on tissue called the choroid. When, because of junyor of desagn, it becomes detached from the choroid, it cannot function properly and the patient feels as if a curtam were falling over part of his eyes. If not treated, the retina as a rule will eventually all peel awas from the choroid, like wallpaper off a wall, and total blandness results.

Modern eye surgeons treat this condition by a kind of electrical spot wilding. This needles carrying an electric current are as plied to the choroid without puncturing at The electric cauterization produces an adhesive inflammation between the choroid and the terium, causing the retina to become reattached.

This method is only 11 years old, but eye surgeons are getting increasingly good results with it. Dr. Meser's report shows. More than one out of three patients operated on at the Illinois Eye and Ear Infirmary since 1938 had restatched retinas with vision ranging from normal to one tenth normal.

HEAT TREATING

A NLW method of heat treating metals by electrical induction, which makes possible hardening of inside diameters of cylinders and other bores, has been developed by Budd Induction Heating, Inc.

The process, which already is being utilized in production work at the Budd Detroit plant makes possible the heat treatment of inside diameters of metal cylinders from two inches in diameter up, and up to 50 feet in length.

The area treated, depth of treatment, and



An automobile hub in the induction heat treatment machine described

the degree of hardness developed are con irolled within exceedingly close limits, while timing of the operation is a matter of seconds.

In hardening inside diameters in which the treated area is of considerable length, such as engine cylinders, a retracting type head, which heats the material by electrical induction, is used. This is drawn evenly through the cylinder, followed by a water quench.

It is anticipated that the process will find



Courtes Max Pactor 37
Gratesque? Yes, but even the granor garts of Brondway and lamon garts of Brondway and the granor garts of Brondway and the grandway and t

wide use in the metal industry. Other practical applications where it can be used to advantage according to metallurgists who have observed the process, are the cylinder laters of Devel, gasobine, and steam engines, oil well casings, and the inside diameters of the sleeves which are the vital parts of all types of sleeve valve internal combustion regime.

GERMANY'S "FAT GAP"

ON of the most conspicuous deficiencies in the German economy when Hitler came into power was the so called "fat gan' the lack of sufficient supplies of fats of all kinds according to Karl Brandt, distinguished German economist now on the staff of the Food Research Institute of Stan ford University To close this gap, the Germans expanded their dairy industry and improved the stock and all equipment Production of oil seeds was subsidized, while consumption of margarine, made from imported vegetable and whale oils, was discouraged Between 1931 and 1936, a 10 percent increase in pork production was achieved by encouraging the German farmer to fatten his hogs

to tatten ins nogs.

In addition to three steps, many substitutes for fats have been suggested Sugar, jum, and marmalade have replaced to some extent butter and margarine. Largely for this reason the German orbard acreage doubled between 1931 and 1936. Sugar has lobe en substituted for fats in baking. The soap industry, which is the principal multipartial consumer of fats, to a certain extent now uses coal and lignite derivatives as substitute for fat in soap manifecture.

Fatless washing powders and synthetic cleansers are now commonplaces. In paint manufacture, cellulose products now replace oils for some kinds of paint, and the use of stainless steel has been encouraged to cut down paint consumption.

25-MILLION-

CANDLEPOWER

SEARCHLIGHT

U SING three of the small capillary water cooled mercury lamps described in these pages some months ago instead of the customary carbon arc, General Electric has developed a new 25 million candlepower



The small object held in the hand is the complete light-source unit of the 25-million-candlepower searchlight shown in the background

exacthight As there are no carbons to be replaced or adjusted, the new searchlight will function automatically. The three high pressure mercury lamps, each rated at 1000 watts and no larger than a cigarette in size, are mounted close together Despite the enormous candilepower produced, little heat is generated, and 70 percent of his is removed to be prompting. 90 gallons of water an moved to the cooling parkets of the lamps cough the cooling parkets of the

FIRE-TRENCH DIGGER DOES WORK OF

MANY MEN

THE United States Forest Service has made important advances in scientific fire lighting this year. They center mainly about such modern devices as airplanes and high-powered chemicals. But the average man on the fire line is likely to name as the most outstanding recent development a contivuence called, after its inventor, a Bosworth trencher.

In fighting forest fires the machine is used to dig a flat trench or ditch in advance of a fire or to turn the flank of the flames. This trench is at least a foot wide and deep enough to remove all leaf mold or other in flammable material. Along this line the fire fighters form to start a backfire or to put out small fires that may jump the trench.

The new trencher, devised by Jim Boworth, assistant supervisor on the Kaniksu National Forest in Idaho, and perfected after much experiment and suggestion, will dig 50 or more feet of trench a munte, de pending upon the terrain and the strength and skill of the operators, and may do the work of as many as 300 men. It has a wheel barrow type of frame with a heavy bicycle wheel to carry the load A small two-rolin der regime with a power shall reaching grantshard is asspended by tween the "harmores" that swing from a central holand throot he woll to one side

The trencher weighs 96 pounds. A har tress of web straps readiles the man thou pushes it to carry part of the weight on his shoulders. In favorable country one man can push the trencher with good effect, but a towing bracket is provided so that one more can aid by pulling where the terrain is touch.

Generally one man goes ahead to clear a path, tossing said fallen logs and loose rick and other encombrances. The machine can be disassembled and carried in a pick up truck or on a man's back in emergencies.

CAR DUMPER EMPTIES A CAR A MINUTE

ANEW car dumper recently built for the Pennsylvania Railroad by Heyl & Patterson, Inc., is capable of emptying 60 cars an hour The dumper is located at Sandusky, Ohio, where it is an example of the most modern methods of coal handling A lift-and turn over type, the car dumper is built to handle 120 ton cars at a rate of 45 per hour or 90 ton cars at a rate of a car a minute. The electrical equipment, supplied by the General Electric Company, 18 con servatively designed to handle the full ca pacity of the dumper on a continuous basis and is so flexibly arranged that the dumper can still handle the maximum load even though a major piece of electrical equip ment should fail

"LEADED" STEEL

"LEADED" steel is the newest trick of L industry to increase the machinability of its product and thus bring lower production costs. But not to be overlooked in the gathering wartime tempo of the nation's industry is the thought that "leaded" steel can increase the production of machine parts that are used in a thousand ways in everything from automobiles and airplanes to tanks and tractors Metallurgusts F J. Robbins and G R Caskey of Bluss and Laugh In, Inc., reported these facts recently

The addition of small amounts of the soft, malleable metal to batches of steel makes 'leaded" steel The result is a metal that an be cut faster on the lathes, gearing, and cutting and milling machines of industry There is less wear in cutting tools and dies. faster production, and fewer breakdowns in streamlined mass production operations All these factors in peacetime mean lower costs that can be translated into a cheaper prod uct, or into increased dividends as the manufacturer chooses. In war it means more machine parts for a war geared industry And metallurgists Robbins and Caskey showed that the strength remains unchanged while the machining properties are in

SOY BEANS

THE 1939 acreage planted to soy pared with the 1938 area of 6,058,000 and the 1928-37 average of 4,246,000. Illinois is the largest soy-bean producing state, with 2,452,000 acres under cultivation.

DAM-SEALING CLAY

LEAK's in joinds, dams, ditches, canals, and the like, may be effectively stopped by the use of Akwaseal, a product of the Wyolak Chemical Company. This material is claimed to the highest type of col. Wheel is a state of the highest type of col. Wheel is varying proportions with soil and by packed around the point of leakage, it wells when wet so that it closes the spaces between the particles of soil.

At a fish hatchery in Marianna, Florida, Akwaseal was applied in the following man ner. The pond was drained, bottom disked, and Akwaseal applied to the bottom and sides of the rearing pond in the ratio of 100.



Demonstrating the fire-trench digger described above

pounds to 500 square feet and worked into the top soil to a depth of 2½ inches and then rolled with a heavy roller The soil formation consisted of sand and clay, the result was a reduction of better than 60 percent of the former seepage.

NEW OPTICAL PYROMETER

AN entirely new temperature measuring instrument—not a re-design of a previous model—the Leeds & Northrup optical pyrometer is now a potentiometer Calibrated, not in milliamperes, but directly in temperature degrees, the measures temperature.



Using the new optical pyrometer

ture more conveniently, and with greater accuracy. It is the first industrial optical py nometer to use the potentiometer method Light in weight, easily and rapidly operated, rugged in construction, it meets those requirements important to an industrial pyrometer, and it also amply accurate for laboratory use This instrument is used in the production of metals, ceramics, glass, and the like, as well as in the laboratory.

INEXPENSIVE FIRE-DETECTION SYSTEM

TNALUABLE in the protection it affords both life and property, while sample and inexpensive, the Fyre-Scout fire detection system will appeal to the average household, shop, farm, or factory Manufactured by Technical Appliance Corp., it gives warning of a fire at its inception

The heart of the system is the decetor head or super-sensitive thermostate switch enclosed in a neat enameled housing, of compact dimensions This unit closes the curcuit and keeps it closed when a dangerous temperature is reached in its vicinity. All detector heads are wired in parallel and connected between a large fire going and a power source—a six-volt dry battery or a bell-inraping transformer. The basic kit comprises going, two detector heads, and 75 feet of heavy-duty trusted-pair wire Additional heads are available separately.



Parts of a simple fire-detection system that operates on six volts

The installation is as simple as wiring a

The detector heads are located high up on wall or ceiling of potential danger spots in home or other building, such as near the furnace, in the basement, kitchen, barn, attic, and so on. The gong is placed where it will be heard best

#OOD

THERE are at present well over 4500 uses for forest products such as fuel, shelter, posts, implement bandles, and others which, like (ellophane and ravon, hear no apparent trace of wood or forest bulletin published by the Forest Service, U. S. Department of Agriculture.

GRANDMA WAS RIGHT,

AT THAT!

CRADMA'S favorite tome of sulfur and molasses turns out to have had more stentific basis than she probably suspected Experiments just concluded at the Massachusetts institute of Technology, show that old-fashoned molasses is just about the best food known for treating mutritional anemia, the kind of anemia due to improper diet

Spinach as a source of tron was thoroughly abchanked by the research conducted by Dr. Robert A. Harris, Dr. John W. M. Bunker, B. A. Harris, Dr. John W. M. Bunker, B. Harris of Land L. Malcolm Mosher: Whereas mulasses has 6.1 parts of usable iron per 100,000 parts by weight, apmach has only 0.5 Beef liver has 5.6, outmeal, 4.6, with apprecis, eggs, and rasans following in that order! The scientists computed usable iron, not total content, for only that iron which the body can use to manufacture hemoglobin is valuable.

The trio also reported that recent medical studies indicate that nutritional anemia is far more prevalent than had been suspected. More than 40 percent of infants have it and the figure for adult women is as high as 70 percent. It is also fairly widespread among growing children.—Science Service.

A FINER PORCELAIN

CLAY

PORCELAIN enamelers have depended largely on Vallendar Clay, which is a German product, because of the fineness of that material Recently, however, the Porcelain Enamel & Manufacturing Company de-

veloped a new elay for porcelain which has been tested in plants throughout the country with highly satisfactory results. Ordinarily, Vallendar Clay passes through a 250 mesh screen whereas the new "Pemo Micronized Clay" is so fine that it could pass through a 2500-mesh screen.

a 2300-mesh screen
This new class is mined in North America
and then prepared by the Micromizer process. In this process the unrefined clay enters a cylindrical chamber at a speed in
excess of 700 miles per hour, causing the
clay to hombard itself. This hombardment
results in the explosion of the clay particles
and their reduction to an average grain six,
of three microns. (Three microns equals
0.000118B1 of an mich.) The terrific speed of
this process causes the impurities size
parties, wood, and the like—to be thrown
out so that the result is a prifectly pure clay

PAINT COMBINATIONS

The Girdon Company has taken advantage of the fact that an annualed sake display will attract more attention than our that is still, and in doing so have volved a unique display for their paints for important the hate provided the prospective user of paints with the best possible manner of finding proper color combanations for both interiors and exterioror home.

This display consists of a columnar collection of attractive, painted miniature honemodels which rotates upon a stationary base



Color schemes on display

Vertically the device is broken into a number of sections, each of which is divided into small angular spaces. As these sections of the column revolve, the paint buyer will note a large number of color combinations presented in an attractive exhibit

PROTECTION WITH

CHARRING, probably the oldest method of preserving wood that is known to man, led to the development of a formula by Carbon Chemical Products, Inc., with which it is possible to "cher" almost any knid of material including metal, concrete.

and asbestos without the use of fire. The process does a double job of preserving and waterproofing materials

This new product is applied easily with a brush or spray, is non-poisonous and non explosive, and will not burn the hands It is resistant to fire and most common acids. as well as to the depredations of termites After the product, which is named Kar Bon-Seal, has been applied it forms a hard, permanently bonded, non porous, flat black coating A gloss can be produced, and paints can be used over this chemical treatment

The base of the product is charcoal ob tained by burning hard wood at 800 degrees, Fahrenheit The finished product has about the same consistency and coverage as paint

The same company also makes another product named Kar Bon Sealuminum which has all the properties of the former but dries to a silvery finish and also serves as a heat reflector for roof work

GERMS TELL WHEN GLASSES ARE DIRTY

WOMEN have a different kind of germs W on their rouged lips than men do, Drs L. A. Dick and G. J. Hucker, of the New York State Agricultural Experiment Station, recently reported to the American Public Health Association. The germs are two varieties of Streptoeoccus salivarius and they were found on the runs of glasses in taverns, restaurants, cocktail lounges, and soda fountains

These germs, harmless in themselves, can he used as an index of how well such glasses are washed between drinks and of how many more dangerous germs may be left on the glasses by careless washing Nearly every presumably clean glass in a taproom will show these harmless germs as evidence of contamination and improper washing. But of all the glasses examined, those in soda fountains were least germy Science Service

SIMPLIFIED PUSH-BUTTON Tuning

THE latest advance in push button radio receivers makes them as easy to adjust as roller skates. It enables any radio set owner to change over the tuned circuits of his receiver with a minimum of effort and in a single operation. This development is incorporated in the new (rosley push button sets in which there are hinged flaps which flip back to expose the adjusting serew or key for each button. To reset a button for



Lifting one of the flaps to re-tune a new push-button radio receiver

a new station, the flap is lifted, a screw driver is inserted in the adjusting screw, and the key is pushed down as far as posible The key is then turned until the dial reading is that desired, the hinged flap is flipped back over the key, and the button is set for reception

ATHLETES HAVE "Fever" Temperatures

THIETES in severa investilar exercise A can show body temperatures that nor mally would mean high fevers, according to Dr Eugene F DuBois of the Russell Sage Institute of Pathology, Cornell University Medical School Dr DuBois, reviewing studies of the body's temperature, showed that the familiar 986 degrees, Fahrenheit, which the clinical thermometer registers normally, is only one single spot between internal temperature and skin temperatures of 932 and lower - Science Service

SMALLEST METAL TUBE EVER PRODUCED

PURE nickel tubs with a hole so small A PURE nicker time with a seriould not that a strand of human hair could not pass through it is believed to be the smallest



World's smallest tube (left) con pared with pin point (center) and huir (right), all 180 magnification

metal tube ever produced, it measures 26/10,000 of an inch in diameter. The hole is about 1/3 this size and the thickness of the metal wall is about 7/10,000 of an inch Pure nickel was used in preference to ordinary steel or other metal subject to rusting because even a slight speck of rust might clog the tiny hole

CHNK

AUNIQUE solvent that combines soap and water detergency with the high solvent performance of benzenes is announced by A F Curran, Research and Development Chemist for The Curran Corporation The new solvent, called Gunk, is, according to the development laboratory, sparkling clear in appearance, highly penetrating, and non-flammable

Small metal parts, stampings, extruded shapes, or die castings dipped in the solvent



The best protection the coffee bean has against loss of flavor due to evaporation of its aromatic oils is its own skin. Hence the Kitchenaid container and electric coffee grinder The roasted beans are kept in the upper container and, at a flip of the switch a measured amount is ground as needed

assume a scoured appearance without etch ing, marking, or loss of weight Such parts may be rinsed by sluicing with water to obtain chemically clean surfaces where painting or lacquering is to follow. It is said that where prevention of storage corrosion or rusting is desired, the parts need not be water rinsed, but are simply drained or centrifuged to remove excess solvent. The light phenolic type film remaining will act as a rust prevertive, making an extra treat ment with oil unnecessary

Paint brushes no longer need be soaked in water or messy oil after using but may, instead, be dinned in Gunk. This solvent not only dissolves the soft paint but emulsifies it as well so that the pigments and oil vehicle may be instantly and completely rinsed away under a water faucet as casily as you would wash soap from your hands

ADVERTISING GOES

NIGHT FLYING

DURING favorable weather, the Goodyear Tire & Rubber Company maintains three dirigibles at their hangar at Bendix, New Jersey During daylight hours they provide an unique means of seeing the sights of New York City from the sky, but at night they carry over the city an ingen tous neon advertising sign by means of which all sorts of messages may be flashed to observers on the ground

These neon signs are made up of 10 32-pound units, each four feet by six feet, on each side of the ship Interchangeable copy can be flashed on these frames from the control board in the gondola, which is connected by means of 330 circuits The signs are completely universal and the operator has a standard typewriter keyboard which, in turn, perforates a small paper tane This is then run through a "translato If the message is to be repeated at regular

intervals, a complete loop is made of the tape so that it automatically repeats itself. Besides advertising copy, wather reports, correct time, air temperature, and news items of civic importance are flashed on the signs. While the ships are aloft they are in continuous two way radio communication with the arrow.

DOUBLE FELT SEAL

BEARINGS

S FALED ball bearings along entirely new and simple principles have been developed by SKF Industries, In. The seal used in these bearings is one that can be applied to bearings having a standard single row S A E dimension of bore, inner and outer



Two felt seals and full-size balls

race width, which up to the present time has not been possible except through the use of small balls and, consequently, loss of bearing capacity

This development has been made possible by departing from the conventional stuffing bot type of scal in fixor of modern air cleaner principles, scaling against dirt by the felt fiber contact on the polished surfaces of the inner race, and by the utilization of the natural tendency of deflected felt to resume its original flat shape.

to resume its original mass singular has singular has been bearing historiant and excludes any dust or dirt entry into the hearing itself, yet the sealing action is so light that the friction drag has been greatly to duced. The hearing is, therefore, suitable over a great range of speech.

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FROM ABDOMEN

A NEW bfe-assing instrument that is a street of a street of a street of a second of a seco

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used to make a hole through skin and muscles for the peritoneoscope to go through Air is first blown into the hole, to make a space between the ussues and internal organs, so that the instrument will not pierce these when inserted

In the war on cancer, the instrument does its part by enabling surgeons to remove a bit of tissue for diagnosis. With a needle interested of a forces at its end, it may be used to drain a liver abscess. The hole made by the instrument in such cases is so small it usually does not need even a stitch to hold it together while healing For this and diagnostic purposes, the patient is not only spared shock of an abdomnail operation but need be in the hospital only 24 hours—Science Serieus.

ODD OPTICAL EFFECT

IN MOTORING

RECENTLY a physician asked The Journal of the American Medical Association the following question "If you park by the roundside and water the automobiles approach you on the opposite aid of the road by means of a powerful field glass, you will find that any car approaching at 50 miles in hour appears, through the miles an hour. There accens to be some relation between time and appear and our perceptive sense, and I am unable to get to the bottom of it."

That magazine answered with mathematics, which we simplify as follows. Assume that the observer is in car A in the accompanying diagram, which is

used through the courtesy of the above-mentioned Journal He views through 8 power binoculars car B, which, as the questioner said, is approaching at high speed through the glasses the distance AB and, for that matter, any intermediate increment of that distance. Thus when the car traditional distance. Thus when the car traditional distance are supposed to the considerably slower than is actually the considerably slower than is actually the case, samply because, in the same length of time it travels over a certain distance, it appears to be covering only 4th the actual distance. Naturally, this explanation would apply only to carse comma head on.

ELECTRIC HAND CHIPPER AND FILER

RECENTLY placed on the market is a new electric tool similar to the small "hand-size" electric grinders but with the



Reciprocating electric hand tool, and some of the attachments for it

With

Converter

115 4 6

to

110 D C

10 Watt

difference that the movement of the tool is reciprocating instead of rotating The handle containing the motor fits the hand nicely Into the chuck may be inserted small chisels for chipping, small files, honing stones, and even small back saws. Two models are made one with a 7/16-inch stroke, and the other with a 1/8-inch stroke The motor is 110 volt, for use on alternating or direct current

NEON WATER GAGE IT TUMINATOR

ALL who have squinted up at water gages on boilers will appreciate the neon illuminator for gage glasses being offered by the Wright Austin Company

This new neon illuminator is a surprisingly simple and efficient device, and con sists of a neon light tube and a magnifying lens placed behind the gage glass

The liquid filled portion of the gage glass stands out as a broad, red neon band, and the empty space above fades into a hairline



Neon tube illuminates the gage

red stripe. The water level can be read distinctly, day or night Neon rays penetrate not only darkness, but haze, steam, dust and fog almost as readily

The neon illuminator is furnished complete with a small transformer and an extension cord ready to plug into 110 to 120 volt, 60 cycle circuit. It can also be supplied for a 25 cycle circuit, and also for 220 volts It is easily attached to almost any standard water gage by two U clamps, which grip around the top and bottom water gage fi tings, and can be attached in a few minutes

MACHINE WRAPS AND SEALS

DEVELOPMENT of a Stretch-Wrap machine for packaging various articles of miscellaneous shapes in Phofilm, is announced by The Goodyear Tire & Rubber Company. Known as the Pfeiffer Pliofilm Stretch-Wrap machine, it takes advantage of the following Phofilm characteristics stretchability when heated, strength increase in all directions when so stretched; extreme resistance to puncture when stretched, making application to irregular shapes easy; self-scaling when heated Thus with the new machine any article can be wrapped and sealed in one operation

The Stretch-Wrap machine should prove

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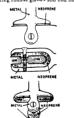
Irregularly shaped objects rapidly sealed in this machine

adventageous to many industries now hands capped with a difficult or laborious wrapping or packaging operation Savings in material consumption is another decided advantage of the Stretch Wrap method Up to 300 percent savings in wrapping material can be effected. For soap wrapping for example, a six by six-inch sheet of Phofilm will wrap the same size cake of soap that now requires a 13 by 13 inch sheet with the wet wrap hand method

For many diverse small wrapping opera-tions not sufficiently large in volume to afford an automatic machine operation, the Stretch Wrap machine should prove to be the ideal answer.

VIRRATION DAMPENER FOR SPECTACLES

AVE you ever considered the installa-H AVE you ever community me too of a vibration dampener on your spectacles? Probably not, but such a device might solve a problem for you, that is, if you are wearing rimless glasses and find that the



Three years of the vibration dampener that holds spectacle lenses

lenses break frequently, a cushion mounting between the straps and the lenses will aid in reducing breakage

In one design of this type a pad of neo prene completely surrounds the lenses, hold ing them in a firm yet flexible grip and protecting them from shock and strain. The elimination of shock and strain also eliminates breakage caused by these conditions

At the top of our illustration is a side view of the strap and lens showing how the neoprene pad fits against the side of the lens. In the center is shown the way the neoprene is carried over between the hole in the lens and the screw that presses the straps to-



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gether. The bottom drawing illustrates the way the proprene cushion mountings are arranged so that no metal will touch the lens

The advantages of this design are readily apparent and include the possibility of using stronger, more rigid straps around the lenses Neoprene is used for the pads because it provides a long lived mounting that will resist the effects of body acids and cleaning solutions. But its ability to resist deteriors tion is not the only reason for its use

For example, if the strap contacts any ma terial containing sulfur, the sulfur will cause discoloration of the gold surfaces and this discoloration might create the idea in the mind of the user that the straps were cor roded Or, to clean up the discoloration, the user might employ a solvent which actually would cause corrosion. So it is impractical to use any such materials for the mounting pad Fortunately, sulfur can be climinated from the neoprene compound without adversely affecting the properties of the compound Such a compound will not discolor the straps, so the manufacturer is able to secure an efficient cushion mounting which will last for many years without endangering the life of the straps

GREASY THUMBS HAVE No Effect

TO any machinist who has had to thumb his way through a greasy data book looking for tapers or thread settings, the DataTule, a handy bitle vest pocket alum inum-cased file of information on things a



mechanic needs to know will be just what he needs A twist of the fingers brings a wealth of data and information into your Lard oil and grease have no effect on the legibility of the enclosed tables

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four inches at the top. When the asphaltic surfacing is placed on the street, this groove is filled with the asphaltic material, leaving a smooth surface which is marked with a double centerline.

In Public Safety, Lieut R O Bennett, of the Lincoln Police Department, describes a method being used to install permanent lane markings in asphaltic streets already placed First, the pavement is softened with a burner, the width of the desired stripe. After this heating, a templet is placed on the surface and a coat of asphaltic emulsion is applied. To this is added a half inch layer of white "Joplin Chats," flint-like stones The templet is then removed and a hand roller which develops over 300 pounds per square inch pressure is used to force the stone into the pavement

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Refrigerator carton: A, storage. B, air space. C, dry ice bunker. D, pade

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THE PROBLEM OF

THE SQUARE

CONTINUING our series of mathematisomething a bitle different If you have found some of the preceding problems a bit too difficult because calculus was required for their solutions, perhaps this will be more interesting

Construct by graphical means that is, using a compass and ruler a square having



three corners at distances of 1, 2, and 215 inches from a point within the square Also,

compute the length of a side of the square As usual, this problem comes from Lieu tenant Commander Leonard Kaplan All correspondence concerning it should be addressed to him in care of Scientific Amerian, 24 West 40 Street, New York, N. Y. We forward all letters unopened

SOLUTION TO OUR

PROBLEM OF THE

DOG IN THE RIVER

Nour December number was proposed a Your December number was proposed or oblem concerning a man and his dog And here is the solution which was promased for this month. It was required, if you don't remember or if this is your first sight of the problem, to find out how long it takethe dog to swim the river which separates him from his master. The dog swims at a rate of two miles per hour, always headed toward the man, and starts from a spot 0.11 miles below a point directly opposite its master The river is 0.48 miles wide and

flows at one mile per hour The following symbols are used in our solution and sketch

the crest line down and presumably stick to their job until the entire dune has been leveled

This method is being used where lands were denuded of sod and where dust storms were numerous in recent years

No More "Burned Our" Cows?

"B URNED out' cows will no longer plague the American farmer Chemists have found that a diet of corn sugar or molasses prevents ketosis, a disease which cuts nulk production and inflicts economic loss, it was announced recently by C. F. Huffman and C. W. Duncan of the Michigan Agricultural Experiment Station

Ketosis, it was explained, is characterized by the mability of animals to burn fat completely "The incompletely burned fatty

V. velocity of the dog. (2 m p h).

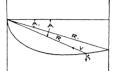
v, velocity of river, (1 m p. h).

f is zero

t, time after starting, hours
R, distance in miles between man

and dog at any time, t. The angle made by R with a line

normal to the bank of the river A_1 and R_1 , values of A and R when



Now, resolving the velocities V and v along R and at right angles to R, we have

$$\frac{dR}{dt} = r \sin A - 1 \text{ and } \frac{dA}{dt} = \frac{r \cos A}{R}$$
Consider next the identity

 $v = V^2 = (v \sin 4 - 1) (v \sin 4 + 1) + v^2 \cos 4$ and substitute in it the values obtained

above for
$$v \sin A - V$$

Then,

$$v^3 - V^2 \equiv (v \sin A + 1) \frac{dR}{dt}$$

Integrating, $(v^*-V^*) \ t = vR\sin A + VR + \ell$ Setting t=0 and solving for the constant, $\theta = vR$, sin $t_0 + VR_1 + \ell$

Hence,

$$(t^2-1) t = R (v \sin 4 + V)$$

 $= R_1 (v \sin 4_1 + V)$

Substitution in this equation of the values given in the problem, $\alpha = 1, \beta = 2, R_3 = 42$, sin $f_1 \simeq 0.11/0.5 = 7/251$ gives the time re quired to cross the river That is, when

$$t = \frac{-\frac{1}{2}}{\frac{1}{25}} \left(\frac{7}{25} + 2 \right)$$

giving a time of 0 38 hours or 228 minutes

fragments are called ketone bodys. The term ketosis implies the abnormal accumu lation of the ketone bodies in the blood and their excessive excretion in the urine

"Their accumulation in the body of dairy cattle is of economic importance because they result in a drop in milk production, in a loss of appetite, and a decrease in body weight in the more pronounced cases Ketosis is the modern name for the disturbance which was formerly referred to when the farmer said that his cow was 'burned out'

OVER-INFLATION IN TRUCK TIRES

DURING the past several years there has been a gradual swing from high-pressure truck tires to balleons. Many truck owners, however, are not receiving full benefit from their balloon equipment because they are continuing to use air pressures more in keeping with high-pressure inflation recommendations and not the pressures recommended for balloon tires

Over-inflation reduces deflection and contact area, causing the tire to ride on the crown This results in the following (1) tread wear more rapid than normal, (2) increased tendency toward bruise or crown breaks: (3) excessive strain on beads and rim. (4) abnormal growth and possible tread cracking, (5) more cuts and snags than would be experienced with proper inflation, (6) abnormal stresses and strains in the tread area which increase the tendency toward tread separation, (7) harder riding and increased up keep on equipment,

(8) reduced non-skid qualities by reason of smaller area of road contact.

Among the recommendations for proper inflation are inflate to proper pressure when tires are cool, if tires are continually under-loaded, use air pressure to correspond with actual load carried (refer to a load and inflation table) . if both load and speed are factors, either load or speed must be reduced to obtain normal service, never "bleed" tires to relieve "build up" of pressure caused by heat. The ratio of tempera ture to pressure "build up" in service is ap proximately 8½ degrees of temperature for every pound of "build up " - India Rubber # orld, from Bulletin No 13, Rubber Manufacturer's Association, Inc.

Identifying 'Shakespeare'

(Continued from page B)

one Joseph Hall who in 1748 was employed to repair and otherwise "beautify" the also found in practically every one of the ancient paintings of Shakespeare that show him dressed as a nobleman

Exigencies of space prevent reproduction at this time of anything approaching a complete layout of the pictorial evidence gathered during our investigation of the three portraits. The triple set of infra red and X ray studies alone total more than 20 plates I shall, however, try to give a general idea of results achieved by outlining briefly our dissective study of the "Ash bourne" painting (page 4)

First brought to public attention in 1847 by the Rev Clement U Kingston, one of the masters of Queen Elizabeth's Free Grammar School at Ashhourne, Derbyshire, this impressive work of art had long been in pursession of one of the old British county families who treasured it as a genuine and contemporary portrait of Shakespeare Mr Kingston knew there could be no question of the picture's an tiquity, for the canvas was in rags and had to be immediately rebacked to preserve the painted image Abraham Wivell, a portrait painter of talent and one of the few recognized authorities on Shake spearean art, vouched for the "Ashbourne" as a composition of the late Renaissance and for its technical relationship to other ancient representations of the Bard Wivell's findings were corroborated by Samuel Timmins of the British Society of Antiquarians and also by M H Spielmann. Shakespearean art authority of the "Encyclopæedia Brittanica" About 11 years ago the por-Brittanica " trait was brought to this country by the late Eustace Conway, who finally sold it to the Folger Shakespeare Library It is generally considered the most beautiful, as well as the largest, of all the many famous old portraits of the nost now owned by this \$22,000,000 foundation It is life-size, threequarter length, covering a canvas 471/2 inches long by 371/2 inches wide

Facing three quarters to the observer's right, precisely as Lord Oxford does in both his Portland and St Albans pictures (Figures 1 and 2). Shakespeare appears as a courtly gentleman of middle life, dressed in a black doublet and black bombasted trunk-hose with inserts of gray satin in the puffed pleats.

His waist is encircled by a rapier belt of

French design, consisting of black leather and gold filigree work, while about his neck is a flimsy and skimpy ruff-entirely out of key with the rest of the attire

He stands by a square edged table, cov ered with a wine red cloth. On the table, just beneath his right arm, appears a human skull or memento more, the same emblem of mortality that Falstaff mentions in "I Henry IV" It is interesting to note that the top of the wall memorial to Shakespeare in the Stratford Church is crowned by an identical example (page 4) of the "Ashbourne" skull - both being minus the lower new

In his right hand Shakespeare holds a small, elegantly bound volume, tooled in gold and displaying open to strings of sheer crimson silk. Eustace Conway and other students of the portrait have opined that this is the poet's private copy of his "Sonnets". A masque of tragedy and rossed spears appears in the center of They are raised above the sur rounding surface and painted in a tone of orange gold quite different from the lemon gold of the rapier belt. This indicates that the masque and spears, like the skimpy neck ruff, are later additions to the original composition

The inscription, AETATIS SVAE 47 AO 1611, in the upper corner of the canvas, to the observer's left corresponds with the chronology of the Stratford man's life, but has been painted in the same tone as the ruff and the masque and spears, obviously at the same time M H Spielmann gave it as his opinion 35 years ago that all these additions are of ancient application. We shall learn more about them in a moment or two, when we come to examine the dis sective photographs

A gauntlet of the type that Elizabethan courtiers wore on dress occasions dangles from Shakespeare's left hand. It is of rich maroon material, tasselled, and appliqued with cloth-of gold tape. A somewhat similar gauntlet will be observed on Lord Oxford's right hand in his portrait which bears the date 1575

Many have remarked on the length of Shakespeare's fingers, especially the left thumb, which bears a signet ring of the swivel pattern, the unmistakable mark of Turning to the St Albans a dignitary portrait of Lord Oxford (Figure 2), which was evidently painted by Marcus Cheeraedts the Younger when the Earl was about 36

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SCIENTIFIC AMERICAN 24 W. 40th St., New York City, NY. years old, we find the same unusually long fingers and thumb. Here they draw attention to the device of the wild boar, hanging around the nobleman's neck (See Figure 61. This boar served as the crest of the famous Vere family to which Oxford belonged. It is one of the best-known devices in British armory.

The matrix of the thumb seal that Shaks-pears wears in his "Ashhourne" portrait (page 4 and Figure 7) is about the size of a present-day aspecte. The original design is not apparent to the naked eye because the matrix has been treated to a daubing of the thick orange gold already mentioned.

When we examine our semi incroscopic close up of the seal, however, it hidden de sign takes form (Figure 11). Underlying shadows, plus broken surface brush strokes, give us the eye, the ears, the long amout, jaws, folling tongue, and tusk socket of a wild hoar: the same armortal device that Lord Oxford wears in his \$1 Mlans portrait!

We know quite definitely that Willin Shakspert did not have a signet of any pattern. For at the conclusion of his will, which was signed at Stratford in February, 1016, when we come to the paragraph reading "whereof! have hereunto put my scale" the word "scale" has been struck out and the word "hand" (meaning handwritten names substituted

In order to find our whether Lord Oxford might have proviseed a space time, I, wrote to the Urbarian of Hatfield House in Heritodshim, the ancient used of the Cecil family with which Oxford was allied through buthrough bu-first marriage. Two dozon or more personal letters from the Farl are self-up to the Company of the Company of the 11 pre-served the Collowing repls, dated Februars 17, 1999.

Linux examined the correspondence of Edwig et Avis, 17th Earl of Voford, in our collection, and find that with one exception all the seals extant are wafer seals of the de Vere arms and show no distinguishable detail. The remaining 1% ample — a small signet seal, the size of a supprace—appear to represent the de Vere crest of a Wild Boar on a correst whom no its entirely. This seal is a very poor speciment and in the proper speciment of the proper speciment of the proper speciment of the property of the p

I. V. Lyle.

From the rubbing of the wax impression which Mr Libs was kind rought to enclose, it is immediately apparent that we have an example of the same swivel type of thumb signet that Shakespeare wears in the "Ash-burne" painting. The artist merely confined his design of the matrix to the wild loar's head instead of meticulously reproducing the whole Vete cress.

Our photographs, desections (Figures 4 and 9) of the "Abhobures" had not only bring it into unquestionable conformaty with the two inserbled Oxford portraits but show how this literary nobleman was long ago converted into a halch-headed counterpart of the synthetic commoner who appears in the stone memorial edity at appears in the stone memorial edity at engraving on the tule-page of Shakespeare's First Folio.

Reference to our infra-red plate (Figure 9) discloses that the original forehead has been raised an inch or more. The crude strokes of the renovator's brush show the same slap-dash haste and the same technical

deficiencies that are apparent in similar operations on the other two Shakespearean portraits that we have found to be disguised likenesses of the poet Earl

The hair in the "Ashbourne" has been re-done to match the synthetic forehead. That the head was originally topped by a normal growth seems evident. Oxford has a good red brown thatch in both the Portland and 5t Albans paintings.

Jand and M. Albana paintings.
The infrared dissection of the neck-ruff is a slot revealing. Undersurface outlines make it plain that this was once a huge make it plain that this was once a huge area of the fliming thing now on view, and that it was of the fliming thing now on view, and that it was of the fliming thing now on view, and that it was of the fliming thing the fliming the flim

The present surface mecruption on the "Ashbourn" "Ashbourn" canava (pag 4), although conforming to Shak-per's personal chroologs, struck Spielman as questionable when he first examined the portrait, which describes as that of "a gentium an perhaps a noble, born and hered." The Shake specarean art authority of the "Encyclopaedia specarean art authority of the "Encyclopaedia case of the lettering, with cross-bars missing from the As and E's, the poor spacing and also distinction It is also worth resterating that the gold paint used for this lettering is of the same orange tone that appears in the raised daubs on the book cover and the disquest dhamb ring

Our X ray photographs of the inscription area (Figure 13) reveal a whole series of clues which, taken together, seem to leave no loop hole for doubt regarding the true identity of the man in the painting

The first of these exposites—the upper half of the figure—makes to plan that the original inscription was womething far different from the one which appears on the sarface today. And although this pratune lettering was long any exaped out—so vigorously that perforations were made in the canvas—t is still possible to distinguish the globelly remainst of both alphabetic charms.

acters and numerals More exciting still, a phantom crest appears just below the inscription. And beneath the crest, our second X-ray exposure has brought to light a full shield of arms, surrounded by decorative mantling and a scroll that evidently once bore a family motto. As a sort of appendage to the whole layout, the artist has added his monogram, identifiable as a conventionalized C K. The entire section, containing this feast of evidence for scholars, genealogists, and art historians alike, was painted from view at some remote period, undoubtedly at the time the original inscription was destroyed. It is even possible that these changes were made in the painting early in the 17th Century so that Lord Oxford in Shakespearean disguise could be used as "copy" by Garret Johnson, the London sculptor who made the memorial effigy of the Bard that was set up in the Church at Stratford

Let us see, meanwhile, what this evidence of the hidden arms and the artist's monogram has to tell us in summing up the case. The recovered device on the upper part of Figure 13 is really a doubt area. Tasks left, the faint black penciling of a leopard or hon appears, while to the right is the white outline of a griffin.

Months of research have proved that two Elizabethan families of Staffordshire had crests that corresponded to the above combination They were the Snevds of Keel Hall and the Trenthams of Rocester Abbey. About 1592, Edward de Vere Earl of Oxford, then known as the most gifted poet and brilliant writer of unpublished comed at Elizabeth's Court, married Elizabeth Trentham, one of the Queen's Maids of Honor, for his second wife. Elizabeth Trentham's father was Thomas Trentham, of Rocester Abbey, High Sheriff of Staffordshire Her mother was Joan Sneyd Trentham, daughter of Sir William Sneyd of Keel Hall. So the combination crest could designate the Countess of Oxford

The shield of arms shown in the lower part of Figure 13, would seem to make this armorial identification positive, for the Trentham arms are described in contem porary records as Three griffins' heads, erased, sable, beaked, gules And the photographic reproduction (Figure 15) of the Trentham shield in stone, which was placed in St Peter's Church, Wolverhampton, some time during the 1580's, corresponds so closely to the phantom shield in our X ray picture that there seems no room for argu ment. The dispositions of the three heads on both shields are identical, the only differences in detail being such as would be mevitable in comparing a finished work in stone with the shadow of a design in paint that has been long subjected to chemical amalgamation with concealing costs

But may be saked how comes it that the literary Farl of Oxford would have his wife's arms, instead of his own, emblazoned on his portrait

Genealogists tell us that it was a common custom in medieval days for knights to honor their ladies in this manner Richard Neville Earl of Warwick-the famous "Kingmaker -is an outstanding example. His great seal bears the crest of his wife, Anne Beauchamp, and his mother, Alice Montague, with no sign whatever of the Neville family arms.

Moreover, we find this statement in Franklin's "The Bearing of Coat Armour By "When armoury was in the making, I adves" no arrangements were made for women to bear arms. If the lady were an herress, or owned lands, her husband bore her arms for her

Upon her father's death in 1587, Elizabeth Trentham had inherited considerable property under the terms of his will

So it appears that, in having the double crest and shield of his heiress wife painted on his own portrait, Lord Oxford was merely following approved etiquette. It is also probable that the painting was originally designed as a personal gift to the wife who brought the harassed nobleman respite from known financial straits, as well as a son and heir In this connection, it is significant that the painting takes its name from Ashbourne, Derbyshire, where Mr. Kingston first drew it to public attention early in the last cen-The "Ashbourne Addition" in this same locality was one of the properties owned by Elizabeth Trentham Cockayne, great-grand-niece of the Countess of Oxford, who became sole herress of both the Vere and Trentham estates about the middle of the 17th Century.

Our final piece of corroborative evidence in this classic example of mistaken identity is the artist's monogram distinguishable in our X-ray picture (Figure 13) The conventionalized initials, CK, when studied in close-up comparison (Figure 14, at left) with other authenticated monograms (same figure) of Cornelius Ketel, the great Dutch portrait painter who was born in 1548 and died in 1616, show conclusively that Ketel must have been the artist who signed the "Ashbourne" canvas in its original, undisguised state. All other considerations uside, the discovery of Ketel as the creator of this portrait should enhance its value far beyond the sum which the Folger Shakespeare paid for it. For the Dutch master is now recog nized as one of the really great portrait painters of the late Renaissance, perhaps the most gifted forerunner of Rembrandt He made his home in England from 1573 to 1581, and during this period and later is known to have done the likenesses of many of the most distinguished members of the English and Scottish aristocracy, including

Moreover, when we turn to the contempo rary account of Ketel's career, published in 1604 by his friend and fellow artist, Karel Van Mander, we find the following significant statement "Ketel also made a portrait of the Duke of Oxford (Edward de Vere), the High Chancellor (Sir Christopher Hat ton), and of many other important members of nobility, with their wives and children Some of these portraits were life size and full length

Queen Ebzabeth and King James

George Vertue, the English art commentator of the 18th Century, also speaks of a large portrait of the 17th Earl of Oxford that had been named by Cornelius Ketel Vertue was not able to true the work at first hand, as it had quite evidently become completely confused with the Shakespearean arcana by the time he wrote. But he remarks that it was once in possession of a Countess of Strafford

Henrietta Maria Stanley, great-grand daughter of Edward de Vere Earl of Oxford, married William Wentworth Farl of Strafford in 1655. She may have been the Countess of Strafford that Vertue mentions

In any event, we are able clearly to connect this remarkable "portrait of William Shakespeare" with the poetical Earl of Oxford and his heirs and descendants in so many ways that there should be no lingering doubt of the identity of the real man of letters beneath the over pointed surface

My investigation to date convinces me that a whole series of portraits of this eccentric peer who had lost caste, political reputation, and wealth for reasons that historians associate with literary and dramatic extravagances, were long since converted into representations of "Shakespeare" The two likenesses known as the Portland and the St Albans pictures, which show Lord Oxford wearing head-coverings, could not be so easily disguised. These bear his name and titles on their surfaces Such a situation should explain logically why eight or more antique paintings are listed by the "Encyclopaedia Brittanica" as traditional portraits of the hazel blue-eyed, auburn haired "Bard of Avon" which depict him in the apparel of a nobleman

And, as the penetrative eve of modern photographic science is focused more sharply upon this extraordinary picture-puzzle, more and more evidence accumulates to argue that we have at last found a visual key to the age-old mystery of "William Shakespeare's" real personality.



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YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use Hence this monthly department presenting a wide variety of discussion regarding fitearms, their handling, and their accessories. Suggestions time reader will be heartly welfcomed—The Edin

SHOTGUN HERESY?

WILEN, in 1807, the Alexander Forsyth, Scotch Munter, received an English patent for a firing look which proved to be the base principle underlying evolution of the metallic cartridge, threech loading, and other modern frozens improvements. British sportsion readily accepted the Forewth determine the received by the sportsion readily accepted the Forewth determine the received method in favor of their old "Brown to receive method in favor of their old "Brown the Kontine Committee and the Forewth and was "object to make and desergence."

When, recently, the W R Weaver Com pany announced a new one-power (no mag nification) 'scope for shotgon use in skert, trap, and wing shooting, the ensuing howl was comparable to that which rewarded efforts of the Reverend Forsyth 132 years ago. We have before us at this moment a letter from "Bill" Weaver which sets forth some strong arguments in favor of his scope, which is 912 inches long, weighs 1/2 pound, and has a field of view of 75 feet at 100 yards. It has normal eye relief of 41/2 inches, but will function satisfactorily at from 314 to 7 inches, and illumination is approximately 120 Reticule consists of a round black dot at intersection of crossed hair lines

Weaver claims regardless of speed, target may be instantly caught in 'sope, abooter knows exactly where center of pat simplifies problem mans have of shootings problem mans have of shootinging, seeperable with hoth eves open, for while aiming is subth hoth eves open, for while aiming is done with one eye, target is seen with both thereby making it causer to pick up target and judge its position and speed, target and in the position of the position of the problem of t

Revolutionary as it sounds, we won't start condemnation proceedings on shorgun 'stopes without a trial, for we'd awfully hate to think that by damning something new we'd make the same mixike as an army which said the detonating principle of firing was "dangerous" and preferred to defend its "Tight Lattle Isle" with finithock muskets.

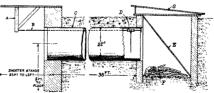
THIS IS THE RANGE THAT ROD BUILD

W/HEN Mr and Mrs. Rod Risley decided to build their attractive and modest little residence in the hills of Westchister County, some 32 miles north of New York



At the shooting position in Rod's range Note the spotting 'scope

Gity, Rod, being something of a revolver and pistol shot, tirted to figure a way to install a small cabber range in his own basement. To be completely satisfactory. Rod decided, the proposed range had to give him 60 feet of shooting distance, offer some satisfactory method of mulling the sound be kept at a minimum cash outlay, even if some personal



Rod's range, not to scale A, braced rafter for target trolley terminal. B, twin wires for target carrier. C, smoke stack (shooting tunnel) in trench. D, target carrier E, steel plate bullet deflector. F, bullet cushion. G, cover of "cubicle."



Target and trolley, Opening of the shooting tunnel is in background

labor and puttering were involved. As the plans for the new home specified a 25 by 30 foot basement the first problem was how to fit a 60 foot range into a 30 foot room

Sconing around the country side, the amateur range builder found an old laundry smoke stack of 1/8 inch cold rolled steel, 22 makes in diameter. Fortunately, there were two sections, each 19 feet long, so Rod consulted his slide rule and ended by buying Still keeping in mind cost of the stack operations. Rod helped his contractor disa shallow, 38-foot long trench which ex tended into the back yard, with a box like hole about 30 inches in width, length and depth at the far end. When the sections of stack were delivered, they were rolled into the trench, the end nearest the house was fitted into a hole previously left in the foundation, the joints were well tarred to keep out moisture, and dirt was shoveled in on th "tunnel". The cubicle like hole at the far end had meanwhile been lined with a four inch wall of concrete on all four sides and had been topped with a wooden cover, weatherproofed with asbestos shingles

By this time Rod's new neighbors were in stitches, trying to emulate Sherlock Holmes To them, the contraption was an air conditioning plant, a new fangled fruit or vegetable cellar, or part of the sanitary system. but Rod said nothing and departed for an other country scotting trip. This time he returned with a rusty steel plate 5% of an inch thick, 25 inches wide, 32 inches long and an armful of old inner tubes from heavy duty truck tires. The steel plate went into the cubicle in a diagonal position and the inner tubes were slashed into sizeable pieces and piled on the sand under the plate, although the neighbors still didn't understand, Rod had completed his bulletdeflecting apparatus

Rod now found he had a distance of 63 feet from the far side of his basement, through the circular hole in the foundation and on down the "tunnel" to the place where the target would eventually be placed Waterproofed electrical cable was strung through the "tunnel" and connected to a light socket equipped with a reflector to throw the light down onto the target. A target carrier of strap iron was constructed in the shape of an "H", with holes drilled in the cross bars of the "H" so that the carrier would ride freely on twin tracks of wire which had been stretched from a basement rafter to the concrete cubicle

The range was finished, the neighbors were finally satisfied, but Rod wasn't He still wanted to muffle the sound, so he built n wooden box 13 inches wide, 16 inches tall and 412 feet long. He lined it with Johns-Manville sound proofing material and succeeded in so muffling the firing reports that Mrs Risley, upstairs in the living room, never dropped a stitch in her assiduous rughooking avocation. She actually thought her industrious husband was trifling at some thing with a small hammer instead of firing a round of some 30 shots. To complete the comfort of his indoor range Rod rigged a bracket from the rafters in which he could insert his telescope at eve level and thus peer into the "tunnel" to count the score after shooting, thereby avoiding hauling the target carrier back into the cellar

Having accomplished the dual feet of fitting a 60 foot range into a 30-foot base ment and of adequately muffling the sound. Risley sat down and computed his costs as follows second-hand steel smoke stack, \$15, cement, \$150, electric cable, socket, and switch, \$150, extra labor \$5, wire, pulleys, rope and strap from for target carrier, \$2.50. sound proofing material, \$2, 150 charge for sood in either muffler box or bracket it came from crates and left over pieces around the house) | Lotal cost, \$30.50 Equipped for a standard 50 foot target, the range has proved an all-fired" success

Pot-Shots

AT THINGS NEW

RKO PATHE's new Sportscope, "Gun Play," shows dramatically in slow and normal motion the interesting possibilities of trap and skeet shooting, particularly so because it was filmed on the 2000 acre preserve of New York's Front and Skeet Club where special ranges are designed as nearly as possible to simulate true conditions of grouse. woodcock, dove, and quail shooting. Active participants throughout the picture are Eltinge Warner and Bob Nichols, respec tively Publisher and Skeet Editor of Field & Stream, Frank Kelley, captain of 1937 All American Skeet Team, Steele Roberts, and A. G. Boesel

HIGH STANDARD MFC Co adds to their 22 automatic pistol line Models A. D. and E. which are equipped with new, long handle, free from magazine projection. These guns have automatic slide locks, heavy barrels, and shoot all makes of 22 rim fire cart ridges, high speed and low pressure. All have Patridge wide blade front and adjust able rear sights, positive safety, walnut grips, blued finish, 10 shot capacity and choice of 41/2 or 63, inch barrel Standard equipment with Model E is choice of right or left thumb rest grip, and, together with Model D, this gun has a heavier barrel than Model A Thumb rests on Models A and D ore extra

ABERCROMBIE & FITCH, in their 1939 fall gun catalog, devote 136 pages to a full range of imported shotguns and rifles, domestic models of all types and prices, and feature their 50th Anniversary as exclusive United States representative of Auguste Francotte et Cie, famous Belgian gunsmiths, by presentation of the Francotte Jubilee double-barrel, hammerless, ejector shotgun in 12 to .410 gage



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How Fast?

W ITH so much stress being placed of late on the matter of high-shutter speeds, we thought it might be in order to provide a comparison of results obtained at relatively slow and high shutter speeds. We set up a toy pinwheel and kept it revolving with the aid of an electric fan, at a steady pace while we made a number of exposures at different shutter speeds. The effect of partial and complete stoppage is partly illustrated in the pinwheel demonstration reproduced in the three examples shown here The first example, taken at 1/10 of a second shows no sign of stoppage at all, giving the effect of a disk. The last, at 1/1000, stopped the wheel practically so "dead" that, paradoxically, it looks as if it



1/10 of a second



1/200 of a second



1/1000 of a second

had been photographed when at a standstill for all the evidence of movement that

Between these two extremes a variety of effects were produced, respectively, at 1/50, 1/200, 1/300, and 1/600, that furnish some idea of motion evidences achieved at different shutter speeds. It is interesting to note that no really strong difference could be observed between the exposures made at 1/25, 1/50, and 1/100, and that the first truly visible difference occurred at 1/200 second

CAMERA ON THE AIR

THE first nationwide radio program devoted exclusively to photography for the amateur was inaugurated in the New York studios of WJZ recently under the guidance and leadership of Herbert C McKay, F. R. P. S, well-known photo-graphic writer and technical consultant. The half-hour program is given every Wednesday evening at 10.30 o'clock over the Blue Network's more than 50 stations throughout the country and is known as "Adventures in Photography," or The Radio Camera Club, membership in which is open to every amateur photographer, who has merely to drop a card or letter to the club, care of Station WJZ, New York City, to be-

come a member.

Mr. McKay, who created the program and is its technical director, advises that a national picture contest is under way under the sponsorship of the club The goal of the program, according to Mr. McKay, is "to make the Radio Camera Club a common bond among all individuals and groups interested in photography.

Two of the interesting highlights of the

program are the features, "What's Wrong With My Picture, Please?" and a dramatized photographic problem. The former is a sont of question-and-nawer box which comprises a round-table discussion including, among others, a professional photographer, an advanced amateur, and Mr McKay himself. Questions are proposed by listeners and the round table discusses the reply over the air Xip Row and Guy Lombardo were the givest on the Irst program which, incidentally, drew a studio audience of more than 300 persons. The dramatized probline, which winds up the program, presents a question in story fash on, listeners are mixed to write in their

BINDING COLOR SLIDES

TEXT to dust and lint, curling transpar encies are one of the worst bugaboos the color slide maker. This is particularly true of the short Bantam Kodachrome strips An effective way to overcome this and to keep the slides as flat as possible under the circumstances is to cut and bind the slides the day they arrive. As soon as you open the package, untoll the strip and hold it unrolled for a few minutes. If you will cut and bind the slides then and there. you will find comparatively little trouble with regard to curling. Also, you will thus avoid too frequent handling of the strip before it is bound and, as a consequence, prevent to some degree the accumulation of lint on the transparency surfaces

CONTRAST IN LIGHTING

THE accompanying illustrations prowed a graphic vample of the megative results obtained with flat lighting and the flectiveness obtained with flat lighting and inflectiveness of lighting so arranged that a more faithful reproduction of the subject is achieved. Figure 1, as can be seen, shows the subject illuminated from the front by a single light lighted near the camera. This type of lighting, though useful in color photography, where the colors in the subject the color of the color of the color of the black and white. Perhaps this is not a happy example, because the subject is all white, or, rather, light-toods. However, ex-



Figure 1



P2 ... 0

cept where one is trying for a high-key effect or some other special result, a flat lighting in black and white will seldom prove attractive.

On the other hand, Figure 2 provides all mosts a starting difference when compared with Figure 1. The light in this case, also a single unit, was posttomed behind the camera and above it, the beam being directed down towards the subject at an angle of about 55 degrees. In both Figure 1 and Figure 2, he light was in front, but a variation in the height and angle of the Figure 2, as a result, shows depth and omners, solidity, strength, and character 1 pages 2, as a result, shows depth and cound ness, solidity, strength, and character 1 is practically lifeless.

RAY-DEL CONTEST EXTENDED

DROMPTED by letters received from amateurs asking for extension of closing date of the Ray-Del Picture Contest after learning that all prints were to be developed in Ray-Del, the manufactures have pushed the date ahead Prints for entry in the contest will be accepted until December 31, 1939. The contest calls for pictures depoting the idea of "Balance."

It's The Man Behind The Camera

BELIEVE it or not. a \$2.50 box camera can take good picture—and win prize to Witness the example of Carl Bakule, of Minneapolis, who paul 50 cents down and 10 cents a week in order to acquire a camera which he otherwise could not afford. Carl has built his own darkroom, flood inplint, and other equipment out of in cans. down the contract of the carlot of the cand. In a "write-up" in the Minneapolis Star-Journal, it is reported that "his film is bought a roll at a time. He can afford only a few sheets of paper at once . . . and he has rarely, if ever, spoiled a picture or a print." Carl says "he can't afford" to miss reposures "because every hit counts."

Among the numerous occasions on which he has won prizes is the selection of his

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photograph "Student of Science," as part of the 58-foot mural, "Youth Around the World," in the International Y M C A. building at the New York World's Fair Carl's picture was one of 63 chosen from more than 1000 entries from amateur photographers in various countries.

(arl writes us that recognition for one of his pictures in last year's Scientific American photographic contest was his 'first great inspiration'. His letter follows

"I am one of your last wear's photography winners (Honorable Montion) I would like to say that your contest was my first great in-piration and Hook upon your magazine as helping me find my forte. (If you could have seen me when I received your letter!)

"Soon after your contest, I won a one were subscription to the *Cunter Magazine* in the Minneapolis Public Library Salon Nine ms first storts with your I have had a good deal of success which is helping me attain my destination. I haven't at present a very good position and through doing photographic subhisting I hope to attain a good name in order to get a good position in the photographic library.

More power to you, Carl

SEE WHAT YOUR PAPER CAN DO

SOMETIME ago we described in this de partment the method employed in making a test strip in order to determine the exposure time required for a given set of conditions as to negative density paper contrast, distance of negative from the easel, and so on. This called for the use of a strip of paper, narrow bands of which were successively exposed for a given length of time. This same method can be used in making a so-called gray scale of each of the various papers you use, exposing them in the same manner as the printing test strip. If the test is carried through for all your papers, you need never wonder again as to the range of tones your paper is able to produce. Also, it will help you consider ably in matching the paper to the particular negative. A gray scale of this type (reduced in size i is illustrated here



A gray scale

All you need is a sheet of photographic paper and a piece of cardboard or other opaque material to limit the area you are exposing Recently there came on the mar ket a handy device for performing this routine in a convenient, simple, and as curate manner. It is called the Havnes Grav Scaler and automatically covers up success sive steps of the test strip

LIGHTING BY THE

CLOCK

SEVERAL persons appear to have discovered simultaneous ered simultaneously that the placement of light sources may be conveniently identified by following the hour numbers of the clock. Thus, with the light at 12, its position is directly over the subject, with the light at 6, its position is from below Similarly, when at 9 and 3 it is at left or right of the subject And so on, with the other hour numbers used either in a vertical or horizontal circle around the subject

MIDGET BULB BRINGS NEW PHASE IN FLASH **PHOTOGRAPHY**

BY the time you read this, the "mighty midget" flashbulb, hardly bigger than a wilnut, will have become available as a regularly marketed product. The bulb is being introduced, according to General Electric Company, the manufacturers for the occasion of the tenth anniversary of the Photoflash lump's debut in America for it was in 1929 that the Mazda lumn



Comparisons

manufacturers introduced the first flash bulbs in this country

Known as the Marda Photoflash Lamn No. 5, the bulb is so small that more than two dozen may be carried in the pocket of a suit coat and more than three dozen in an overcost pocket or a lady's handbag. Featur ing a bayonet type base, similar to the bases of lamps used in automobiles, the bulb is wire filled, is coated with a lacquer safety jacket, and has a total light output of 13,000 to 15 000 lumen seconds. The bulb may be fired only with dry cells (two or more), not house current, and is designed for use with all cameras except those of the focal plane shutter type. The advent of the mightly midget' presages the introduction of smiller and less cumbersome reflector

In this connection, it is interesting to recall a prediction along these lines in the August, 1948, issue of the Geraert Sensiuzer, in which C W Gibbs, A R P. S. wrote as follows

"Speaking of flash bulbs it is our opinion that, now that the bulbs are being made so small, the next advance in their manufacture should come in the reduction of the size of the base so that these small bulbs and the smaller bulbs of the future would fit the socket in an ordinary flashlight. Photour others schlow use 110 volts for constant the bulbs and such an advance could result in a saving of equipment if it were only necessary to carry around a fountain penflashlight for ignition instead of the present apparatus

DEPTH OF FOCUS AND DEPTH OF FIELD

Till SE two terms are popularly used in-terchangeably, but one hears the term depth of focus more often than the other Actually, so long as a term is generally in terpreted in the same way, it really does not matter a great deal, except to philologists, whether the term is used correctly or not. One might point to quite a number of words in the English language that, in the strictest sense, denote something altogether different from the meaning popularly attributed to them. The same with the terms depth of focus and depth of field

Depth of focus is generally understood to mean the extent or depth of field from the plane nearest the camera to that farthest away in which objects are sharply recorded by the lens at a given aperture and distance from the principal point of focus. Correctly, this phenomenon is termed depth



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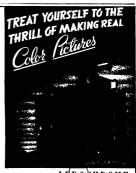
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STUDY IN TRIANGLES OF course we do not recommend our

of field. Depth of focus, on the other hand, refers to what might be called a latitude of sharp focus, a narrow field, with the lens at a fixed point, within which any one of several points may be used as the point of "sharp focus" This will be readily understood by those who have focused on a ground glass. You will remember that on occasion, after you had focused on one point and found it sharp, you were able to move the focusing screen a little, or accidentally sarred it forward, and found that desnite this the focus remained visually undisturbed. We know of course, that there can be but one point of sharpest focus, but this is only theoretically so, because the eyes, and it is with these, after all, that we attempt to focus an image, can actually focus on several different points and obtain visual sharp focus at any one of them Since we have no other means of focusing except with the eyes we must, therefore, take their evidence for it

How To LIGHT A SPHERE

TO still all curiosity from the start, let us explain that the picture shows a bath soap ball - nothing more which is the only thing, curiously enough, that we could find that would answer the descrip tion of a white sphere. The two tell tale highlights at side and front tell the light-



ing story in a moment. One light was placed at the side, the other in front. In this man ner the tonal range is permitted to progress evenly from brightest to darkest area and thus describe the shape of the sphere. Unless care is exercised in placing the lights, particularly the front one, which must be moved back and forth until the desired effect of even progression of tone is achieved, a shadow band will show in the center, caused by the greater intensity of the side light.

"Triangles" as a method of portraiture. We all know that the lighting has still to be completed by a soft light in front to fill in the shadows and illuminate the eve One of the reasons for making it was to provide a subject for an exercise in patternmaking Here we have a succession of light triangles, in the forehead, the cheek, the

BOOKS ROOKS a r Amateur Photographers

New Ways in Photocraphy, by Jacob Deschin. Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur in one way or another. It covers the whole range of amateur photography. discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other sub-divisions that will not be found elsewhere in as clear and concise a man-ner, \$2.85.

SO YOU WANT TO TAKE BETTER PIC-TURES, by A. P. Peck. A friendly, face who has his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to utilize it to best advantage Over 200 pages, dozens of illustrations \$2.10

Universal Photo Almanac and Mar-KET GLIDE How, when and what to photograph in order to make m with your camera, where to sell dif-ferent types of prints. \$100

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CHAMPIJN ON FINE GRAIN, by Harry Champlin, A complete hand-book on the entire subject of fine grain, including formulas and how pound and use them \$185.

PHOTOGRAPHIC HINTS AND GADGETS, by Fraprie and Jordan. How to make all kinds of photographic accessories. from film clips to cameras to lighting equipment, and so on, 250 articles and nearly 500 illustrations, \$3.60.

PORTRAIT PHOTOGRAPHY, by H Will lams. Fundamental principles of composition and lighting, paving the way to satisfactory results in this particular branch of photography. \$4.35.

PHOTOGRAPHIC ENLARGING, by Frank-lin I Jordan, F R P S One of the most interesting and authentic books most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salon-winners, show the value of correct technique. \$3.60.

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ROOKS RAAKS



"Triangles"

nose, and shadow triangles in the area around the eye and the area between hp and cheek. The answer might be, So what? And maybe you are right. However, it does seem to offer some possibilities in the way of trick photography, puzzle picture making (Guess who?), and so on The lighting was from a single source directly over the subject and slightly adjusted to light the areas shown

CAMERA BOOKS FOR RENT

A LARGE photographic supply store in New York City has hit on the idea of inaugurating a circulating library of photographic books on the plan of the fiction rental libraries that have been in vogue for years. From the worn appearance of the books on the rental shelf and the report of the management, it appears that the scheme is going over in a big way Fulfilling the store's expectations also is the fact that borrowers, after reading the book, have, in a number of instances, been inspired to nurchase a copy.

WHAT'S NEW

In Photographic Equipment

Cif you are interested in any of the stems our advertises of the mour advertises columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request.

B2 SHUR-FLASH (\$3.95) and A8 CADET FLASH (price not yet announced) Box cameras featuring built-in synchronization and separate flash units. May be used for "straight" photography by day or by night, or for synchronization of flash and shutter for flash exposures Flash unit is light and compact, providing polished metal reflector on light-weight plastic base. Uses two penlight-size batteries and can be fitted with any one of several types and sizes of stand-ard photographic flash lamps. B2 takes eight 214 by 314 mch pictures on B2 rollfilm. High-quality meniscus lens, two diaphragm openings; optical direct-view finder; easy loading with hinged back having acoure latch; compact, rigid; attractive waterproof covering trimmed with black enamel and satin finish chromium A8 takes eight 1% by 2%-inch pictures on A8 rollfilm

VICTOR FLASH SYNCHRONIZER (\$8.75) Syn chronizes shutters equipped with cable release socket, at speeds up to and including 1/500 of a second Features Easy attach ment to any camera, uses no battery current except for igniting lamp, shutter tripping drive will trip either automatic or pre-set shutters with uniformly accurate timing, protects shutter mechanism by stopping cable plunger at exact tripping point, re

lease button operated simply as cable release, difference in pressure on release cannot upset timing, quickly adjusted or set for any shutter, synchronizes all speeds of shutter when adjusted to any one of them. has adjustable height reflector to center any flash bulb, polished aluminum, 6 inch re

anastigmat, 85mm focal length. Shutter seeds \$2 second to 1/250, time and bulb Measures 5% by 3% by 112 inches closed Takes twelve 214 by 234 inch pictures on B2 rollfilm Focuses 315 feet to infinity by ad justment of focusing ring on lens mount Shutter of pre-set type released by button mounted on camera body. Molded top contains eye level view finder, built-in shutter release, opening release button and winding

Agea Speedex Camera (\$27.50) Lens 1/4.5

knobs. New type, self-creeting platform and front, brings lens and shutter assembly quickly into rigid picture taking position Recessed tripod socket centrally located on base of camera, single film window peep hale resultioned in center of camera back Special eveready leather carrying case avail able of \$4.75

SAYMON BROWN EXPOSURE METER (\$1.85)

Gives direct readings Entirely self contained Measures 12 inch by 34 inch by 134 inches overall Chart based on films hav ing 24 Weston rating, instructions provide for adjustments from 8 to 128 Simple ad matment of meter to individual evenight at start sets system for all future readings Finished in chrome, equipped with leather case Can be used held in hand or fitted into camera shoe Shoe can be supplied for

MASTER LEICAMETER Has all Weston features, but gives readings in direct shutter speeds "High Illumination" scale gives direct shutter speed readings from 1/2 second to 1/1000th second Reading is based on 24 Weston and diaphragm opening //63 For "Low Illumination" scale, film speed is 50 Weston, and scales based on use of f/2 diaphragm opening Calculator dial indi-(ates diaphragm stop to use when film speeds are used other than those on which scales are based. Calculator dial can also be employed to determine shutter speeds to be used at various disphragm openings, for any particular opening

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nits adjustment of tripod at any height Reversible tips provide choice of rubber pads or metal spearheads to insure firm grip on any floor or ground surface Large diameter machined aluminum head provides firm sent for large and small cameras, preventing vibration caused by flexing of camera case itself when supported on small surface

HOLLYWOOD VIEWER PROJECTOR (\$39.50)

Combination viewer and projector for 35mm slides Built of aluminum, baked dull enamel finish. Viewing screen mounted in deep set viewing box, permitting slides to be shown in daylight, or, with turn of knob, viewer is changed into projector Cooling system efficient, 100 watt projection lamp used Accommodates slides of any thickness Available are black carrying case with com partment for slide file (\$4.50) and slide file for 100 slides that fits into carrying case (\$2.50)

TAIBOTT 35mm STRIP PRINTER (\$150) Consists of die out mot board printing frame and lump housing complete with cord, switch, 7'2 watt opal bulb. In operation, merely frame negative and paper, place lamp housing over aperture, and expose

CARCILLE TRANS SHARP (Model K for Koda chrome), 25e, Model D for Dufavcolor. 40c). Designed for viewing negatives and transparences

F.R. DARKBOOM PAPER CABINET (\$3.95) Accommodates one full gross 5 by 7 mch paper, one full gross 8 by 10 and one half gross 11 by 14 paper Made of wood Interior disided into several sections to accommodate various paper dimensions. Shelves finished smooth. Cabiret permits quick access to all sizes of papers. Light trap makes cabinet light tight. Metal clasp keeps cabinet shut when not in use and prevents door from accidentally opening Rubber domes on bot tom prevent table scratches. Light in weight, guaranteed light tight

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VICTOR SUNFLECTOR Designed for balancing lighting when making exposures in direct sunlight. Compact and portable. Sunflector is nine ii ch, convex mirror formed to curvature of 40 inch diameter sphere Mounted in aluminum casing Chromium finished support, through friction joints, may be variously positioned to direct reflected rays as desired. Front feet rubbertipped Chromium finished loop forms base or provides means of hanging Sunflector on wall hooks, pegs, etc. May be used as snot light for highlighting when subjects are in shade for concealed lighting, and specially effective in relieving shadows in color pho-tography outdoors. Most useful in movie and still photography when subject is single figure or close up

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JACOB DESCHIN, conductor of our "Camera Angles" department, will usuer in these columns questions of general interest to amateur photog raphers. If an answer is desired by mail, enclose a stamped, addre sed envelope. Overses should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials. The Editor

Q. I have six rolls of film exposed three years ago, not developed. They were given normal full exposure. What special precautions should I take to obtain the best possible result?-L. V. P.

A Develop the films for 20 percent longer than the normal developing time For example, if development for a given temperature is 15 minutes, prolong development to 18 minutes. This should result in satisfactory negatives it nothing has hup nened to affect the emulsion since the negatives were exposed

O. Will you kindly give me information as to the best method, as well as the most economical, to obtain ositives for projection purposes from 35mm black and white film'-P. A. S.

This procedure is exactly the same as that employed in making contact prints from negatives. The 35mm negative is placed in close contact with 35mm positive film, emulsion to emulsion, with the "glass" or celluloid side facing the light Regular printing devices are available for this purpose, but a less expensive method is the use of the 35mm wooden printing frames designed for printing either one or six at a time Process the 35mm positive film in ac cordance with the formula recommended by the manufactures

Q. Will you please explain the differences between a focal plane shutter, a front shutter, a Compur shutter, and a Robot shutter in their actual operation9-H. S.

A The focal plane shutter consists of an opaque rubberized fabric or metal cur tain which moves under spring action close to the plane of the film. The speed is varied by adjusting the spring tension or varying the size of the opening or slit which extends the whole width of the picture area. A front shutter is a so called "silent" portrait shut ter consisting of a set of moving blades and which is used in front of the lens and is operated by a cable release, adjustments being made for time, bulb, or an instan-taneous exposure, the latter usually being about 1/25 or 1/50 of a second, the actual apeed depending on the pressure exerted on the release. The Comput shutter is of the so-called between-the-lens type and consists of several blades of very thin metal which rapidly open and close. The speeds are regulated by a spring operated escapement consisting of a train of gear wheels shutter of the Robot camera is a special disk type design which is operated by a spring motor. When the latter is fully wound up, as many as 24 exposures may be made in rapid succession without the necessity of rewinding

Q. (an you give me an effective formula for a print cleaning solution? -L. K.

A Make up a little solution containing equal parts of ammonia, wood alcohol, and plain water Apply with a soft rag, rubbing gently over the print surface

Q. Recently I saw a reference to the fact that a "buffered borax" formula can be made merely by adding borio acid to D-76. Can this be done and if so, how much per 32 ounces of D-76' How does the buffered borax formula compare with D-76 as to grain and the effect on film speed? The camera directories list the Lorga as Model II, III IIIa and IIIb, while the camera shop ads call them Model D, F, C, these two methods of reference

-J. A. H A By adding 14 grams (203 grains) of boric acid crystals, the D-76 formula is converted to the "buffered borax" formula, which, therefore, is as follows

Water (about 125° F) 24 ounces 29 grains Metal 3-1/3 ounces Sodium sulfite, desiccated 73 grains Hydrogumone Borax (20 Mule Team) 29 grains 203 grains Boric acid, crystals Cold water to make 32 ounces

At 65 degrees, development for fast emul sions is 20 to 22 minutes, for emulsions of medium speed, 16 to 18 minutes The grain of the developed image is finer, without any apparent loss in emulsion speed.

The numeral designation of the variou-Leica models, formerly employed only abroad, has recently been adopted in this country to replace the alphabetical system Becoming accustomed to a change from one system of model designation to another naturally takes a little time, especially since the alphabetical system has been in use here for such a long while.



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AMERICAN MEDICINE MOBILIZES

By James Rorts

R ORTY, the author here presents one side of an at present extremely contro versual subject, that is group medicine compulsory health insurance, government ally subsidized medical care and 'bringing adequate medical care to all the people subjects on which there is much, very much to be said on both sides. Readers who prefer a calm, objective, unemotional, and scientifically weighed discussion of such issues probably will be irritated by this book which is at times scornful of opinion not fully in agreement with the author's Those who enjoy a fight will like it, if they also like its point of view. It is an excellent compendium of arguments favoring socialand medicine, flavored with a bountiful background of gossip about prominent per sonabities (358 pages, 512 by 812 inches) -\$3 10 postpard - 4 6 I

SYNCHROFLASH PHOTOGRAPHY By Willard D. Margan

F-LASHLIGHT bulbs, used over a wide mark aware's of natural lighting conditions have done much to change and enhance photographic technique. Here is told the whole story as it applies particularly to the advanced amateur—equipment and how to use it under all conditions 1200 pages 6 by 8½ inches, 200 photographs and drawings)—8210 postpared —A P. P.

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By Adelbert Schapp

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BETTER BUSINESS LETTERS By L E Frailey, B A

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sould be the elimination of such rubber stamp plarases. "In reply would wish to state," "We are pleased to attach hereto," "Pleg to acknowledge, "Thanking in antier pation," "Hoping we tremain," and universus other hold overs from the digl. 90°. This book covers various types of business- letters, corrispondence problems, promotion betters and has a large section devoted to bettere and qui questions. Numerous examples of letters, good and bad, are given 198 pages 5% b. 83°.

inches) - \$2 10 postpard — F D M FIFI D BOOK OF ANIMALS IN WINTER Ann Haven Morgan, Prof Zoology, Mt Halvale College

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MACHINE DESIGN By Stanton E Finston

HEAV in mathematics, this volume presents those fundamentals of theory and analysis which are bases to the field of makine design. It is intended as a reference for the designer as well as a testinosis for the student in this field. Its range is indicated by some chapter headings is indicated by some chapter headings formalisment principes—implies and compound stresses, bolts and screws, shafting and keys, frection drives, sport and bevel and keys, frection drives, sport and bevel micros numerous illustrations, 3–34 10 post-pad—F D M.

GUN COLLECTING

By Charles Edward Chapel (1st Lt U. S. Marine Corps, Retired)

ANY gun fancier who has never ridden the hobby of firearms collecting will, in all probability, reach the last page of this book with the firm resolve immediately to inaugurate his hitherto neglected gun gathering activities A pleasing, narrative style smoothly and rapidly motivates the

presentation of historical and informative data on antique arms and the pleasure and profit to be had from their ownership. Although written for the novice, and therefore equipped with an excellent glossary, index, bulbulgraphy, and source has to collectors, museums, and periodicals dealing with the hobby, the vetran also will find this volume with the control of the control of

MODEL RAILROADS IN THE HOME By Earl Chapin May

M OBEL rathood fever may be compared with a dorace, one is rather susceptible or immune. In this book the author exposes the reader to the holds. For the immune we explains some of the fascination, and how at all started For the unweighble he tells how to start, huild, and operate a system. Many interesting sidelights and pointers are offered for those indeed with the fiver. The latter will particularly like the weekabdara section in which many trends of the special jargens of radiorading have been beed, with definitions (289 pages, all the rather design of the special jargens of radiorading have been beed, with definitions (289 pages, all the rather design of the present jargens of radiorading have been beed, with definitions (280 pages, all the rather designs).

DIESEL ENGINES, THEORY AND DESIGN By Howard E. Degler, M. E., M. S.

STUDENTS and designers in the automotive field will find this book to be a practical text on Diesel engines, dealing as it does with such phases as efficiency, thermodynamics, fuels and combustion chambers, testing and performance, and principles of design. It is not in any sense of the word a book for the beginner but is written rather with the assumption that the reader is equipped with a knowledge of the principles of mechanics and has a general acquaintance with internal combus tion engines Thorough understanding of the text requires a certain amount of mathe matics (270 pages, 6 by 814 inches, well illustrated with drawings and half tones, graphs and tables)—\$2.60 postpaid.—

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A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

FROM the day when the book "Amateur Telescope Making—Advanced" was first published, with its defauled chapter on Walkden's Riches Field Telescope, the compact type of instrument, mekanized the compact type of instrument, mekanized the compact type of instrument. In the these the compact type of the compact of the comtended to the compact of the compact of the scientific data is show at one Wilky Way view the greatest possible number of stars in one field, and the viewing in the Milks



Figure 1: RFT, version by Morse

Way is very milky indeed--myriads of stars. Such a telescope is quite small and stubby -it is demonstrable both in theory and fact that a large telescope would show fewer, not more, stars. It has a rather deeply curved murror and therefore is not suited to the tyro's maiden job-since deep mirrors are harder to make, but could be the ama-teur's second or third job. Foreign commentators say we Yankres "go" for anything biggest or smallest, longest or shortest, braviest or lightest, or anything, so long as it ends in 'est," and so there must now be hundreds of these Richest Field telecopes in use, judging from reports we receive. Here are pictures of three of them The first (Figure 1) is by E. H. Morse, 2401 Mar Vista Avenue Altadena, California Usee photo of his 15" reflector in "ATM," p. It has a 512" mirror of 22" focal length. "It has exceeded my expectations in performance Morse writes "In fact," he continues. I have had more fun with it in two hours than I have in many nights with my large telescope."

The HFT in Figure 2 was made by Howard P. Smith, Ir. (18) North Park Ave. mo., Tilon, Corpta, and has a 67 mirror of 20° I I Smith states that "the definition is superly." He puts in a claim to being the voungest to make an "RFT—age 13. As every less vonths under 18 ever make telescopes of telescope making is co-suitally an adult hobby—we suspect the will retain a saidth hobby—we suspect the will retain

vs record easily enough
the third "RFT" (Figure 3) is by B L.

Harrell, 114 South Street, Gadsden, Alabama It has a $44_4'''$ Pyrex mirror of $20^{1}2'''$ f I, in a cedar tube, and is equatorially mounted on an old transit tripod

"HERE'S something that, until a few days ago, was quite new to me, and I feel that the amateurs should know about it," Russell W Porter says in sending the note which follows.

"I think I am safe in saying that the average mirror maker, when texting with the kinferdge at the mirror's locus troot, not at the centre of curvature's lackes it for granted that an even and uniform cut off indicates a perfect parabolish of Bosyver, this seems to be not precisely true, who the problet and image are sufficiently separated for convenient observation. The following note, made by D- John A. Andersen, eventive officer in charge of the 20% convenient of the convenient of the convenient of the services the second of the convenient of the convenient of the services and the convenient of should not be uniform when testing a marabolish of the force."

The other day, Dr. Anderson states, one of our opticians called me in to see the test of an f/16 paraboloid of 26" aperture. The set-up was the regular one with a full-



Figure 2: RFf, version by Smith

sized flat, and the conventional Foucault kinfe edge. Pinhole and image were separated by a small distance—about ½" or less. The optician had found that the cutoff was not changed by rotation of the paraboloid on the flat. The small diagonal also was found to be free from suspicion.

In the horizontal cut-off, Dr Anderson continues, the shadows came in from the left and right equally [see Porter's drawing, Figure 4–Ed] and in the vertical they came in from both ends of a diameter inclined about 45° to the vertical

"A reference to pages 100 and 101 of Dr Gardar's "Optical Design", or any other description of the formation of pure third order coma, will account for the above observations cracily. The interesting thing to remumber is that the effect is so easy to observe even when the off-axis angle is only 325 minutes of are.""

Supplementing this compact statement by Dr Anderson, Porter writes, "It should be noted that the shadows referred to are some what fainter than the familiar shadows seen at the center of curvature. The diagrams may help to show what actually takes place Figure 4 is the appearance of the shadow when the knife edge moves in from the left Figure 5 represents three zones, a, b, c, arbstrardy selected on the mirror, and the numbers 1 to 8 refer to octants discussed below Figure 6 is a schematic diagram showing the three images formed by the zones a, b c of the mirror. Now if the knife edge cuts in from the left in Ligare 6, it collides with light rays coming from I and 5 on the mirror. Hence the shadow shown in Figure 4. If the knife edge makes a vertical cut off (say, from below) it extin guishes light reflected from 2 and 6 on the mirror, and hence the resultant shadows creep in at 45"

"The images," Porter continues, "produced by anold axis pundo and kind edge are included in a 60° angle tregardles of the separation. There of axis condition can be overcome by interposing a half-silvered alapsoid on the merco's axis, so in figure 7. The diagonal must have a minimum takeness to avoid double rife torus. Our method, deserbed in Strongs new work, "Procedures in Experimental Physics," page 75° is to half-silver a time of lacquir stricted over a frame."

"The full inte of the book referred to by Dr. Anderson is "Application of the Algebraic Equations to Opinal Design" by I C. Gardner, May 1927, Superintendent of Documents, Government Printing Office, Washington, D. C."

FLATS are sometimes as temperamental as prima donnas. If F Dall, 166 Stock ingstone Road, Luton, Bedfordshire, Eng



Figure 3: RFT, version by Harrell

land, relates in a private communication, how one misbehaved "I had an experience with a flat which I made for A. P. Norton (of star atlas renown) which has rubbed home its lesson. The flat was for a Newtonian and was a properly shaped oval of 214" minor axis, 11/32" thick I started by making a circular flat large enough to cut out two ovals, using polished plate completely free from strain, one side to be



Figure 4: Horizontal cut-off



Figure 5 Three arbitrary zones

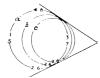


Figure 6 The deep-dyed theory

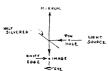


Figure 7. Half-silvered diagonal

ground and worked to a flat. I succeeded in geiting flatness within 1/20 wave in four or five hours' total work. Now comethe rub! I cut it in half, lathe-ground, an oval from one half, ground the back and, on testing it before silvering, found it was no longer flat. The error was a regular bend of a few millionths of an inch-far more than I could tolerate for a first-class flat, although even then it would take a trained eve to detect its effect in the tele scope. No alternative but to cut another flat, using the remaining half. This time I didn't grind the polished back and on test, when finished, it still was flat! The apparent

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THE BEGINNER'S

SEMI PORTABILITY, pernuting, a telescope weighing 190 or 200 pounds to be transled out of doors and, within the hints of one's dooryard, shirted from place to place, is often forced on the beginner by circumstances. Later, when the long cared telescope bug has bitten him till he is far gone and past hope, he may throw up his job, sell his home, and drag through the place of the place of the place is a wide histonia and better events, and there he may have a telescope on a fixed lose under a permanent hosque.

Two semi-portable telescopes mounted on caster tracks are shown here, the first an 8.7 made b. H. R. Ferrig, Cheef of Yard and Terminal Operation, Rock Island and Pactific Railway Co., Chreago, Ill. He calls it "From Junk to Jupiter," as the mounting is made of old motor car parts. For the pedestal, a rear howing was boiled at its bell end to a truck, or "dolly," on rubber-tired sweet.





easiers. As this would be fat too light and top heave, a hill barrel was set around it and filled with concret. Cuts were add to the stability. Total weight, 250 pounds. "I know of melting I have ever undertaken before," Ferrig state, "where far gave me the satisfaction of seeing my rab rub rub, might after might, above develop mis a telescope, come into the edge of the field of view and may accord to the field of view and may across the mirror without even a blur."

Another sem portable is the one at the right, made by Robert F. Smith. D.D. S., Medico-Dental. Bilg., Sort ments, Calif. Staring at the bottom it has three castors; Staring at the bottom it has three castors; as 3 '16' steel plate reinforced with angle and a 3 '16' steel plate reinforced with angle upper, a 3 '15'' to 2 '15' weblid reducer, on, a welded ron taper, 43'; standard to reduce 2'15' double heavy pupe which of a precedent of the same diameter, machined for inside learning. 2'' double heavy pupe also machined internally. Welding was done in beel alsops. The whole is both next and mechanically well proportioned. Such as menting should be mexpenses.

TELESCOPTICS (Continued from preceding page)

explanation is in line with some earlier experiences of the surface tension effects of polished glass, and the moral is: 'don't grind the polished back of a flat mirror after finishing the front.'

JUST as we go to press, the November of number of the Journal of the Optical Society of America comes out, containing an article entitled "A New Method for Testing Cassegram Mirrors," by Dr. E. Gaviola, of the Observatorio Nacional at Córdoba, Argentina. Too long (4 pp) to reprint here at present, the gust of it may be gathered from the following

he gathered from the following
Dr. Gavola (whose photograph, by the
way, appears in "ATMA" at p 478 and
who has done much research at Pasadena
—see also p. 76, "ATMA", — and who is
as one of the problem of testing and
correcting the Casegrain aecondary of the
22" telescope at the La Plata Observators,
but had no flat of that size and no Hindle
sphere. So be thought up the new test.

Directly in front of the convex he put a mask - typical kind. Close to that he put a convergent lens - a had lens serves as well as a good one - a trifle larger than the secondary and with f I shorter than the r c of the convex Using monochromatic light and a test rig in which k-e and sht were virtually coincident, he determined the position of the image of the various zones Next, he removed the convex from the set-up and put a small flat at proper distance beyond the lens, so that the new mage would return to the ke end, and once more measured each zone Amateurs who want to try it may obtain the November number of the "JOSA" from the offices of the Optical Society of America (American Institute of Physics), 175 Fifth Avenue. New York, for 60 cents.

In the same number of the same journal there is a 15 page paper by Ricardo Platzeck and Dr. Gavola, entitled "On The Errors of Testing and a New Method for Surveving Opinal Surfaces and Systems." Fortunately, it involves precision in workmanship not ordinarily reached by the beginner. The paper shows that the regular method of testing is not accurate enough to

work to a close degree of precision. The new method consists of determining the consiste or line of the center of curvature of the surface elements. The method may be used in the Cassegram secondary test described above, also to determine astigmatum, to study Schmidt correcting plates, single lenses and lens system A wure is used for ke, to give higher precision to Note from Porter, Pasadens: "Cavolia has



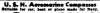
Figure 8 Coelostat by Morse

just been here and told us of a new says of making kee test at c of c. Dr. Anderson saxs it's O.K. If so, then all nurrors this figured are over parabolized." Evidently the same test. And how Ellison, if he wire alive, would chuckle! Vindication for his under correction argument

As started above, these two papers came to the the day when the present mates had to be sent to press, so there was time to read only the first one better than settledly. The second is illustrated with interesting force grains of secondary nones too subtle to be seen in ordinary testing also, unlike the testing part of the seen in ordinary testing also the mate and the seen in the

SUN telescopes, described in Porter's part of "ATM," seemingly seldom are made. Just why amateurs pass up the only star whose details any telescope can reveal at all, and whose details are varied and everchanging as well as conspicuous, is something of a puzzle Anyway, E H Morse, 2401 Mar Vista Ave, Altadona, Calif. has made a 6" sun telescope whose coelostat is shown in Figure 8 "It has 15' f 1" he writes, "and is mounted in my workshop on a plan very similar to that of the Snow tele scope on Mt Wilson All three mirrors are unsilvered, which brings the light down almost sufficiently for the eye, although I have a selenium glass wedge to reduce glare when necessary Observations of the everchanging features of the Sun are even more interesting," Morse states, "than the same-

ness of double stars, clusters and so on."
In your copy of "ATM," unless you have
the recent and corrected pranting of the
treent action. We suggest that you rearrange
page sequence as follows: Change p 37 to 10,
42, 28 to 39, 39 to 40, 40 to 41, 41 to 37 and 14
42 to 38, and theresiter read in that sequence. How these pages ever got out of
sequence, and stayed so many years thus
without being complained of by any reader,
is a second purel. How the book's editor
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THE A R R L ANTENNA BOOK IS a 144-page paper covered book, well illustrated with drawings and photographs, which gives not only the fundamentals of radio antennas, but also presents complete specifications and designs for various modern types. American Radio Relay League, West Hartford, Connecticut -50 cents

THE RESISTANCE OF NI RESIST TO CORROSION BY SWA GETS AND APPAGE Illustrated folder which decreases the results of experimental testing in sewage disposal plants. The describle characteristics of the alloy Ni-Resist are pointed out. The International Vickel Company, Inc., 67 Wall Street, New York, New York—Crafts.

Now and Ice Photography, by H. W. Wagner, is a 50 page booklet, with stiff paper covers, that gives the amateur photographer a broad knowledge of the condutions which must be met and overcome in successful photography of this type. Camera Craft Publishing Company, 425 Bush Street, San Francisco, California—4100

THE MERCK INDEX, fifth edition, is a 1060page limp bound book containing 5900 descriptions of individual substances, 4500 chemical, clinico-chemical reactions, tests and reagents by the author's name; formulas for preparation of culture media, fixatives and staming solutions, useful tables, antidotes for poisons, literature references and other dependable information. Merch and Co., 161 Nixth Avenue, New York, New York, Sex 920.

GREATH SAFTY IN NIGHT DRAING IS devated to a downsoon of the sealed beam headight system which is being used on over 95 percent of all 1940 moor cars made on the United States. It describs the system completely and presents numerous time completely and presents numerous ston United States. It describes the systom completely and presents numerous older types. Automatice Soliet Foundation, 500 Markon Atenue, New York, New York. —Gratic

101 Weinisc Ideas for Low Cost Mais Transact, is a 16-pag thoroughly illustrated pamphlet which tells it dark and simply of the many was in which welding can be applied by users of merchaners and metal products. The illustrations show the wide warret or Jobs that or he handful by this process. The Lincoln Hertric Company, 128B Cost Road, Cheestand, Ohio. Sentis.

Systees IN ON PAYSAYS on 121 page book which present eight pages on various aspects of the solutest, ranging from "The American Pattert System" through Thren tions and Cordination," "Industrie and Patterns," and "the innerty and Patterns," of "Other National Welfare and Darries," Another Solution, "American Patterns," Another National Welfare and Darries," Another National Welfare and Darries, "Another National Welfare and Darries, "Industries of National Institution to others, \$100 to cover printing, handling and mading

Whatter Fitters is a 40 page illustrated booklet which deals with filters from both the practical and theoretical standpoints, and well appeal equally to the commercial photographer and the serious amateur Reference tables and selection of the proper filter for a given need Lustman Kodok. Compans, Roch kester, New York—17 cents

DOWNTAL DATA BOOK contains important new information concerning the labrua tion of the alloy Downtal. Among other things, it covers such operations as roll forming and due drawing, hand forming power pressing, die design, and forming of extruded shapes. The Dow Chemical Company, 30 Rockefeller Plaza, New York, New York—\$100.

GOMMERCIA. PROTOGRAFIE WITH - 1881. MINISTERIC CAMIGA, IN C. A. Goldner, is a 96-page book that can do much to guide the footsteps of the amatur photographer who would like to make a business of his hobby. It tells where to look for business, how to get started, and details the most profitable markets: Camera Craft Publishing Company, 425 Buth Street, San Francisco, California—43100

FLUORESCYN MINERAIS, by W Scott Lewis, is a 15 page mineographed pamphlet which explains phenomena of fluorescence and phesphorescence, and tells how various light isources may be employed in experimental investigations. A listing of fluoresceng minerals is included W. Scott Lewis, 2500 Beachwood Drue, Hollywood, Los Angeles, California,—15 cents.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar Editor Scientific American

APPORTIONMENT

A RADICALLY new basis for calculating francement was established in a recent Fed eral Court decision. Heretofore, when a literary or dramatic creation was found to be an infringement of a copyright, it was generally held that the copyright proprieto had the right to recover all of the profitrealized by the infringer through the use of the infringing composition. In the case under consideration the Court held that where part of the profits were properly at tributable to the copyright work and where the remaining profits were properly at tributable to other factors, the profits should be apportuned and only that portion result ing from the exploitation of the copyright should be paid to the proprietor

The suit was brought by the owner of a copyright on a play, against a moving poture producer, and after rather extended litigation the Court found that a moving picture made and distributed by the producer infringed the copyright on the play The case was referred to a Special Master for the purpose of determining the amount of damages. The moving picture producer introduced evidence before the Master, which apparently was not refuted by the copyright owner, that many factors in addition to the story contributed to the success and popularity of a play, such as the popu larity of the actors, the reputation of the director and producer and the amount and quality of advertising. On the basis of this evidence the Court awarded 20 percent of the profits received from the moving picture play to the copyright proprietor and concluded that the remainder of the profits were properly attributable to factors other than the story.

UNRECONSTRUCTED

THE difficulties encountered by the Reconstruction Finance Corporation in connection with trade marks pleiged as security for loans is illustrated by a case before the Federal Court in New York. In return for a loan, a shoe manufacturer had pledged its assets, including the trade mark "Arch Aid," in the Reconstruction Finance Corporation. Thereafter the shoe manufacturer went through bankrupter, During the bankrupter, proceedings the traeed do not common thaffair of the bankrupt as soon as possible. At a public sale conducted by the trustee, the Reconstruction Finance Corporation purchased the real caste, futures, and trade mark, together with the good will of the business and thereafter attempted unsuccessfully to sell the bosoness strate. Finalls it was forced to sell at public auton all of the physical assets with the exception of the factory flowers, it all not sell the trade marks and good will. In the mantime a former officer of the bankrupt company organized a new company and proceeded to manufacture shows and to use the trade mark Arch Au? In order to protect its assets the Reconstruction Finance Corporation brought suragainst the new company to restrain use of the trade mark.

After reviewing the factors outlined above the Court pointed out that under our law a trade mark does not exist in gross but must be a part of a going business. In the present instance the Court nounted out that the trustee in bankruptey had discontinued doing business, that the Reconstruction Finance Corporation had sold the furniture, machinery, dies, and natterns which were necessary to conduct the business, and that accordingly there was no good will or business to which the trade mark could attach. Under the circumstances the Court concluded that the Reconstruction Finance Corporation did not own the trade mark "Arch Aid" and was not entitled to restrain its use by the new company

restrain its use by the new company
In reaching this conclusion, the Court
stated

"The plaintiff's acts amounted to more than abandonment. They amounted to the destruction of what was necessary to the existence of a business to which good will, trade marks and trade names might attach."

RECTIFIED

WE have heretofore discussed on this page the rights of an unwinter who discussed an impactned uncention in confidence to a manufacturer. Where an invitation is achieved under such ceremitation in the confidence when the manufacturer is a legal obligation upon the manufacturer is not breach the confidence and thou manufacturer is not breach the confidence with the manufacturer in the manufacturer was bound the permission and on collect damages for the unauthorized use. In certain easier the Court sharp going of a set to high that the manufacturer was bound by the confidence even though the idea disclosed to him did not form proper subject matter for a patent.

In a recent decision a Federal Court has placed a very important restriction on this principle and has field that in order to impose an implied obligation upon a nanufacturer under such circumstances the invention or dea submitted must be new In the case in question an inventor alleged that he had suggested to a metal refining company the possibility of separating zine from cadmum by means of a rectifying column and through the use of fractional dutiliation and rectification. Thereafter it was charged that the refuning type when the charged that the refuning type the conline of the control of the control of the After reviewing the testimony submitted at the trial, the Court concluded that the idea of refuning metals in this manner was not no obligation was placed upon the refuning company to refun from using the process

ompany to refrain from using the process. In this connection the Court stated

in this connection the Court state.

"The evidence also fully supports the finding of the District Court that at the time of the alliged disclosure the plantifs older was not novel. Consequently, even if he had succeeded in common gibe trial court that he had disclosed his side to the defendance employees, he still failed to season the burden upon him of proving that the idea was novel. This it was necessary for him to do in order to impose an implied agreement upon the disclodular to refrain from its use."

REPACKAGING

M FR (IANTS sometimes repackage the products of a manufacturer and the question there are s. as to the right of the manufacturer to the products of the products of the product of the pro

In a recent case a merchant purchased a well-known face powder in relatively large packages and then repackaged the powder in smaller pickages for sale in the popular priced chain stores. His package was marked with the following statement.

"Bourjois, Evening in Paris, Face Powder, Repacked by Hermida Laboratories, Wholly Independent of Bourjois"

This statement was objected to by the tradi mark proprietor on the grounds that it did not clearly indicate that the package was not the original product of the proprietor and that the proprietor was not responsible for the contents thereof. The Court agreed with the trade-mark proprietor and required that the rypsikaged merchandish emarked with the following notice.

"Hermida Laboratories, Inc., not connected with Bourjois, Inc., etates that the contents are Bourjois. Exempg in Paris Face Powder, independently repacked by Hermida Laboratories, Inc., at Landen, New Jersey, without the authority or consent of Bourjois which assumes no responsibility for the contents."

In its opmon the Court pointed out that in most countre, as for instance England, France, and Germany, the trade mark law does not permit the unauthorized use of a trade mark on a repackaged product. How does not permit have in the United States as interpreted by the Supreme Court, the Court concluded that a descriptive use of the trade mark was permitted as long as it was seconducted that descriptive use of the trade mark was permitted as long as it was second the trade of the tra

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AMATEUR photographers who feel that they should be able to make money with their cameras will find in this book many hints that will be of value. A series of articles tells what, when, and how to phototells what, when, and now to photo-graph, how to sell your photographs profitably, how to handle your equip-ment, what picture journalism con-sists of and how to make contacts with editors, and many other things with editors, and many other things that the would be photo journalist will want to know. A pictorial section presents some of the work of this country's foremost photographers, a large formulary gives in compact form most of the standard formulas. The market guide section tells who purchases what kind of photographs, approximately the price paid, and gives other pertinent data regarding hundreds of publications that are in the market for photographs

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The SCIENTIFIC AMERICAN DIGEST

Of General Interest NINETY-SIXTH YEAR

ORSON D. MUNN. Editor

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HEAT caused by the impact of tires on high ways is one of the most important prob lems tire engineers have to face. Hence they use actual tires would require large, expensive test machines, and considerable power As ex-plained on page 95 of this issue, the B F Goodrich Company does the job with small samples of rubber in the flexometer illustrated on our cover

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50 YEARS AGO IN . . .



(Condensed From Issues of February, 1890)

PANAMA CANAL. "The indications are that another effort will soon be made to complete the Panama Canal. a nad perhaps on a new basis. This new plan is to construct a canal that would allow of the writt and casy passage of vessels, and would reader healthful and hubstable a large area of land that at present sidiers from the unstaposition of swamps and marshes. The project, in short, is to make a lake in the interior by means of the water from the liver Charge. As this lake would be 24 kinetics, the contraction of the contraction of the contraction of the large would impude the course of vessels along this waterway but the strong double chamber fook that would be but at a sich end?

GUN-"The 9 inch gun mounting herewith illustrated, and which will serve as an example of the type generally known as a carriage and slide in the British service, is intended to be fired over

a 6 ft parapet or from a gun Dit As the platform or slide is mounted on a ring of live rollers, an all-round fire can be obtained A special feature in the gun is its capability of firing at night aights are illuminated by a small incandescent lumn the rays from which, passing through a lens, are converged, so that only a minute point or line of



minute point or line of 0. The sight, is obtained. The carriage admits of 15 deg elevation and 7 deg depression being given to the gain. This allows objects quite close to the gain to bin, and also of a range of about 8,500 yards being attained. The penetrating power of the projectile, even at this great range, is at least 3½ in of iron, which is quite as much as some of the older classed but still errecable, remoids carry on their sides. There is an electric firing key in the form of a pistol, which is beld in the hand, so that no delay is occasioned by looking for the firing key.

TUNNEL—"Work upon the tunnel under the Hudoon River, connecting I-rase vita and New York (Aty), has been alwely progressing, but in the course of a few weeks is to take a new phase. The nort interest and already settlems well toward the center of the river from the I-rase shore, and it is proposed to start a lateral connection therefrom to the lags of the south tunnel, in order to work both east and west from its center. This would give, in connection with this shore ends, four separate working faces."

CONSERVATION.—"Rultoards and the 'man with pun' are proming too much tor gone, large and small, the first making easily accessible what, not long upo, was remote, almost trackless, widerness and mountain fastness, and the breech loading gun, especially the magazine type enabling the veriest vivo to ind his mark. Happity in the 'ellowstone Park are collected some herds of the noble game our rounning the broad continent in countless thou ands. What remains is in said need of protection from the pelt hunter and the wanton-dayer."

ELEPHANT "The normals of Cevlon have recently mentioned the death of an elephant that was well known on the island and had been seen by several generations of Englishmen He was one of the hundred elephants that were taken by the English goverament in 1815, when the Kandyan dynasty was overthrown. At this epoch, the elephant was said to be fifteen years old. If this is correct, he died a natural death at the age of eighty-nine years"

TYPE—"The substitution of mechanism for hand labor in the setting of types, although long delayed, may be now considered as realized, and the day cannot be far distant when the type-setting machine will be the principal rehance in all properly organized printing establishments."

HYDRAULIC TRANSMISSION—"Few Londoners are aware that there are now under the streets of the micropals forty mild pippes charged with a pressure of 750 pounds per square inch. The mains are of cast iron, varving in internal diameter from 7 miches to 2 inches, and are kept charged constantly at a pressure

of 750 pounds per square inch by powerful engines. This power is supplied direct to lifts, preuses, and other purposes of a similar character without the use of any engine or power-producing machinery, and can also be used for driving engines of special construction in the sense was a steam of case set.

PATENT OFFICE.—"The place of the Patent Office among governmental agencies as unique as it is important. It is concerned neither with the collection nor the expenditure of the ordinary public revenues. I nobitrusive and unsensational in its work and methods, it asks nothing of the Treasury excepting moneys which its patroas

urv excepting moneys which its patrons contribute, and nothing of Congress excepting measures to secure its highest efficiency."

SPEED—"There is no swith thing in this day and generation—as "making haste clowly." If the Chiego bounces man could be shot through a preumatic tube into New York City in the space of a few minutes, the limited express train taking inventy-four hours to reach there would no longer be patronned. And if the New Yorker could laid in Laxepool in less than two days wan as ar line, the ocean greybounds would find their day of useful neers had field. Speed is the necessity of necessities in our time, and if lightning speed can be obtained, nothing but lightning speed.

AGES-. "This century has already passed through the phases of a cotton age, an iron age, and is rapidly being transformed into an electrical age."

AND NOW FOR THE FUTURE

¶ Man is a walking hotel for parasitic worms. By Benjamin Adelman

¶ Beryllium, a strategic material of war, plays its rôle in alloys. By Philip H Smith.

¶ Animals used in ancient Roman gladiatorial combats rode on mechanical elevators

¶ Practical benefits to industry of pure science research. By A. Cressy Morrison.



"YOU'RE TELLING

"That's a funny one You're telling me what a great thing the telephone is As if I didn't know!

"Why, I'm one of the main reasons there's a telephone in our house For you can bet your life I keep the folks pretty busy around here

"Just think! If we didn't have a M E !". telephone, we couldn't order things in a hurry from the stores And Grandma couldn't call up to ask if I had a tooth And Daddy couldn't

talk to us when he's out of town And Mother would be tied down just something awful

"And suppose one of us suddenly took sick? Or there was a fire? Or a robber, maybe? Well, I don't worry about those things when I see the telephone

"Doesn't cost much either, my Daddy says And Mother says, 'I don't know what I'd do without 11 ' ''

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OUR POINT OF VIEW

Patient Money

V OUR true research worker m any of the fields of pure science is having a wonderful time. He is following a system—if such it may be called—that at first glance would seem to the hard-headed business man to be highly impractical. Yet the results are so often eminently practical that the same hard-headed business man must sooner or later accept the system of faith and let the research worker go his own unhindered way.

When the pure scientist sets out to find something practical, he apparently turns his back on the goal. To the casnal observer he strays so far afield as to seem to be entirely off the track But that is the system of pure science first you must cultivate a large bump of curi osity, a bump that will urge constantly along unexplored paths, regardless of how unpromising they may seem at first Then you must set out to satisfy that currouty about all kinds of things that may have any connection, no matter how remote, with the problem in hand During this process you will perform all sorts of apparently foolish experiments, these often leading to side experiments along entirely different tacks

Continuing, you will "play" and "waste money," as our hard-headed business man might say But during the process you will be learning many things which, correlated, soon start to build a picture that holds promise. You will have investigated fundamental principles, accepted certain facts and re iected premises that have failed to prove up. Keeping both eyes open at all times you will have found a hint here, a fragment there. Your imagination, playing over a broad field, will have enabled you to see clearly many things that would escape the observer who was concerned only with end products, with practicalities. And out of all this may come a new industry or a rehabilitated old one. based on what you saw in a pinch or a drop of something unexpected

While du Pont chemists were "play ing" with pure-science research, one of them noticed something unusual. A certain procedure yielded a material that an procedure yielded a material that was unexpected unlooked for The results is still off the article starting on page gap laying of these still be a tricle starting on page group of industrial products that will playing of these chemists has come as group of industrial products that will be a still be a still

ings, fabrics, brushes, and other commodities will pour from a figurative test-tube.

Buried in the article mentioned is a near-tragic note, lightly touched upon in passing. At one point in the research, the line of approach that was eventually to lead to success was almost abandoned! Prospects were dark, hope dwindled But persistent curiosity, backed by "natient money," continued to probe and, probing, came through with a triumph of pure-science research Here is a lesson that should make many an industrialist besitate and think deeply before he cuts off the financial life stream which is making possible a niece of research that, at the moment, does not seem to be getting anywhere -A P P

Technological Unemployment

WHATEVER else this year's census indications, put the queetus on the theories of the technocrats. We say their "theories" rather than the technocrats themselves for the simple reason that the latter are very much a going concern—at so much per membership

lust before the turn of the year, understail production stood at 125 percent of the 1923-1925 average. This was ingher than the 1929 average of 119 percent. The roll of the unemployed last October was about 8,150,000. Unemployed in 1929 averaged less than half a million. It is these figures that provide a field day for the "technological unemployment theorists". "Just as we told you," they'll vooferate, "machines have replaced so many workers that we now have better than 1929 production and nearly 8,000,000 more idle than we had then."

But just as thousands of would-be conomists have agnored certain truths during recent trying years, these theorists will forget to mention to you a few pertinent facts. The most important of these is that, with production now only slightly higher than in 1929, employment in October was nearly 46. 500,000 as compared with 1929's average of 47,925,000. Thus, for practically equal production, machines (and other factors) have displaced about 1,500,000 – not 8,000,000.

The principal point here is that of the 8,000,000 unemployed, the largest proportion are new workers. This will show up in the census this year. Also a large percentage of this total are added in the estimates merely because they have re-classed themselves as workers by reare-

son of being on certain "made work" projects or on relief. Otherwise they would never have been considered

Machines have undoubtedly taken their toll of jobs. Shorter working hours have partly offset this. Yet we have done one splendid thing that many predicted we would never accomplish. carried production to and beyond that of 1929. And we have not finished yet. We still have to supply the needs, not only of the six or eight million increase in population, but also of many who have skimped in their buying for fear of the future or because they had to sup port these others The prospective market for both raw and finished products is, indeed, enormous. It is represented by both the normal demand and the deprivations of years Many more years will be needed to meet that double de mand and, in the effort to do so, industry will carry production to new heights. far beyond the 119 percent of the momentous year 1929 -F. D. M.

Do Men Like Them Thin?

OVERWHELMINGLY do statisticjust published by the Metropolitan Life Insurance Company-which
ought to know-prove that our women
are no longer fat. Detailed tables subdivided by ages and heights show that
women of every age group and every
height group became lighter by an average of three to five pounds in one decade.

These reductions are attributed to four main causes: Health science has constantly been urging that there is an excess of illness and death among the fat. Fashion decreed the slim figure. Science showed that it is better to eat less of the right foods-those rich in vitamins and minerals—than more of the wrong foods, those rich in calories: quality versus quantity. Finally, machines do more of women's work, and so the women need less working fuel. (Some of the reductions have been hadly overdone, also, with illness, even death, the sequel to worship of a downright fetish)

Thus science seems to have changed things around quite a lot; what will Nature do? If there is anything in Darwin's sexual selection, Nature will be feat some of these man-made changes. In about 20 years there may prove to have been a lower marriage rate among women who are alim now, assuming that men on the whole "don't like them thin." Nature may have the last word, after all—the last laugh—A G. J.

Personalities in Science

PHILO T. FARNSWORTH -- inventor of electronic television -- might have made an acceptable concert violinist. That is what his mother had honed for him. He acquired an elementary skill with the bow at an early age, and even at that time exhibited the kind of persistence that leads to success. But how could a youngster keep his mind on delicate shading of musical interpretation when such complex subjects as Einstein's theory of relativity, the structure and behavior of atoms and electrons, and associated mysteries, haunted his every wakeful hour? The lure of science won

The pattern of this young inventor's life departs greatly from orthodox stories of scientific success. He is large ly self-educated No hallowed fellow ships, no rubbing elbows with eminent researchers in great laboratories, smoothed his way. Yet, in 1921, as a 15-year-old high-school freshman he demonstrated mastery of his theory of television Farnsworth's very first in ventions embraced electronic means for picking up, transmitting, and receiving images via radio waves. There were no moving parts. This was in 1927 when the art of radio broadcasting was still young and Farnsworth was not quite 21

Today, Farnsworth is vice-president, director of research, and a member of the board of a going concern that bears his name. Farnsworth Television & Radio Corporation.

More than 100 Farnaworth patents cover all manner of television development, applications for 80 additional patents are pending A long late of these represents unquestionably, original art. and form the basis for significant patent interchange agreements that the company has recently consummated with the Radio Corporation of America and other important factors in the undustry

Ferneworth was a farm boy, at the age of 6 he connected his mother's sew ang machine to a toy dynamo and used he power thus generated to drive a toy motor Later, when assigned as "muscleman" to run his mother's manually operated washing machine, he deviced manifest motor drive and spent the new-found time reading science books at the nearest library. He attended school some miles from the farm, overing the distance on horseback. As a high-school freshman, he exhibited definite mathematical genius, "sold" the



PHILO T. FARNSWORTH

science instructor on the idea of admitting him to advanced courses, waded through every scientific book on which he could lay his hands, sought special instruction before and after school hours, "crammed" on certain subjectand jumped into college courses in science

His father died in 1925 and Fainworth faced the necessity of contribut ing to the family upkeep. He opened a radio shop. It failed He took a job in the railroad shops, but the work was too strenuous for a youngster of slight build He answered a "help wanted" advertisement and was bired as a helper by a professional fund raiser. At this time, the "electronic television theory appeared to be a long way from realiza tion and Farnsworth decided to write it up as an article and sell it to a mags zine. His new employer became interested, took Farnsworth to a Los Angeles patent attorney, who in turn arranged for a consultation with an eminent scientist. The latter expressed amazement at the originality and daring of Farnsworth's plan and said If you have what I think you have, you have

the wolld by the tal." This statement impressed a banker. The latter "sold" friends on the idea of backing Faris-worth. The youngster promptly married the girl of his choice, reinted a small house in Los Angeles and converted it into a research laboratory—the first Farisworth had ever seen. He and his wife built most of the shop equipment.

Then came the more complex task of creating his pick-up, transmitter, and receiver. Meeting with difficulty in finding skilled persons capable of building his specialized parts, he piaceceled alone. Farnssorth repractify demonstrated his genus by acquiring knowledge of optice glass blowing, and several other arts essential to the progress of his experiments. Perer by piece, he gradually transformed his theory into

In some respects, the inventor of electronic television resembles a hero of "Horatio Alger" fiction, yet few men of flesh and blood have reached such heights of scientific actuality in the short span of years that cover Farnsworth's life

FOR PROPELLER DESIGNERS TO STUDY

EFFICIENCY of design of marine propellers, as well as many mathme movements, may be studied in photographs such as this one made by light from the strobescope discussed on page 82. This photograph courteey "Flash," fascinating book of "stopped motion" pictures



As pointed out in the accompanying article, many crime investigators feel that old-time headand shoulders "mug" pictures of criminals hould be replaced by some such modern method of photographic techniqu that shown at righ

Photography In Crime Detection

PHOTOGRAPHY makes many value able contributions to modern scientific crime detection. Without it, the law enforcement officer would be minus many valuable records, deprived of a most efficacious method of personal identification, and seriously handi capped in his technical laboratory in vestigations of crime.

The police were quick to recognize the value of photography; its first landmark in police history is the early use made by Alphonse Bertillon, Chief of the Judicial Identification Service of France, in the latter part of the 19th Century For many years thereafter the use of photography by the police was generally confined to its application to the problem of personal identification, and in this respect the record and filing factor of the photograph of the crim-

was filed beneath the classification

sted method of obtaining front, profile and full-length views in a "mug" photograph

Valuable Contributions . . . Need Seen for Uniformity of Photographic Records . . . Automatic Cameras for Picturing Criminals in the Act

By J. EDGAR HOOVER

mal was much more highly stressed than it is today. In those days the facial features of the crimmal were measured. as well as the bony structures of vari ous parts of his body These measurements were worked into a classifica tion system in an effort to record his individuality for filing purposes An im portant supplement to the classification was the photograph of the criminal which

> The Bertillon system of personal identification, as it was called, has been supplanted today by the fingerprint system which is infallible and more easily handled. And today, even though the photograph of the criminal is still placed on his fingerprint record card, it is not for the purpose of supplementing the identification system, but rather to have available a copy of his photograph if needed for investigative purposes.

In more recent times photography began to find a new place in police work in providing an accurate record of the scene of crime. traffic accidents, and the like. Figuratively speaking, this permitted bringing the scene of crime directly into the court room and thus giving the jury a comprehensive understandmg of the setting.

Naturally, as scientific laboratory practices were adopted in law enforce ment for the analysis of evidence, laboratory uses of photography became frequent and most helpful; and today the application of photography to the scientific analysis of evidence is highly developed

"M UGGING" is the police term used to designate the photographing of a subject in custody for record purposes. It is a highly valuable phase of the police record. No longer necessary as a means of classifying the individuality of the person concerned for filing purposes, it is rather used to have on record a recognizable photograph which can be displayed to victims of other crimes for their identification or used if the subject becomes a fugitive sought by law enforcement authorities.

There exists in the United States today a rather deplorable lack of uniformity among police and penologists in the preparation of these "mug" photographs. Perhaps the most prevalent method is to take a portrait type, front



Such photographs of dentures may eventually lead to the identification of unknown dead

and profile view of the head and aboulders of the subject Some effort is being made to standardize the procedure of preparing this front and side view so that a uniform perspective is obtained by all police photographers. There are, however, many critics of this method. Many investigators consider that a full-length portrait-the so-called "stand-up" photograph-of the subject should be prepared These advocates contend that such a picture is much more natural and more readily recognized by a lay witness. To this is added the criticism from another school of thought which recommends that the criminal not be photographed alone. either head and shoulders or stand-up. but should always be photographed with his associates in crime, this being the so called "gang" photograph in which a group of three, four, or five criminalare lined up and photographed together

THE next controversy ranges around the clothing which the subject should wear in the photograph Many contend that the picture of the newly committed penitentiary inmate, made after he is clean shaven as to face and head, or otherwise barbered and clothed in a uniform manner, amounts to almost a deliberate effort to render the photograph difficult for use in investigative purposes Agam, penologists are being urged to prepare a photograph of the criminal in street clothes just before his release after serving a long sentence in order that the existing photographic record may not be so obsolete as to be useless. To this might be added the controversy between those who feel the subject should appear in at least one view with his hat on, as against those who would primp him up with nicely brushed hair for the occasion

Routine photographs are made by police of amnesia victims and of unknown dead. This procedure permits wide circularization for identification purposes, including newspaper publications if deemed desirable Of course,

the amnesia victim presents no special problem in the photographic procedure. In the case of unknown dead. however, a number of law enforcement agencies have made many advances in the development of special methods designed to produce as near a life-like photograph of the features as possible. Some of this work approaches the artistic in a rather re markable way Special preparation of this kind not only increases the likelihood of reliable identification but lessons the shock which a gruesome photograph might



Photographs of valuable jewelry are of assistance in case of theft

Searching the photographic file of the single fingerprint section of the Federal Bureau of Investigation at Washington

have on bereaved relatives. Where decomposition is in an advanced state it is sometimes possible to photograph only parts of the body such as the teeth, for identification purposes

Another application of photography to the person in police work concerns its use in making a pictorial record of wounds or other special conditions of the body. In cases

of vicious assault or murder, photographs of the victim are frequently made and include close-up pictures clearly depicting wounds and other effects of weapons These make a valuable record in discussing the effects of such assaults and graphically illustrating the exact nature of them for the information of the court and jury. In an effort to improve the likelihood of identification from photographs, police research workers are not only striving for uniformity in making the photographs but are conducting interesting experiments in the use of stereo-photogranhs, color photographs, and sound motion pictures of the criminal.

No discussion of police "mug" photographs is complete without a mention of the use of "protrait parle" This system of the "spoken photograph" was initi ated by Bertillon and today it has a valuable use in crime detection Investigators are taught how to analyze a photograph in order to memorize the features and readily recognize the countenance of the individual if he is met in the flesh. The investigator learns to divide photographs into types and the classifications are based on such factors as slant of the forehead, the length and shape of the nose, the evebrows, the ears, and other features of the countenance As a result of such detailed study of the picture, he is able to memorize it and a great many others, and thus recognize persons on the street or elsewhere when he has never seen them before except for a study of the photographic like Desses

Other uses of photographing for identification purposes include the photographic recording of manimate ob jects, such as jewels and stolen articles of various kinds. When the article is being sought after it has been stolen the investigators are limited to the use of pictures made prior to its loss These are usually in the possession of the owner, frequently made for some other



purpose On the other hand, booty is often recovered from thieves or their fences and the true ownership established only after photography and publication The police usually recommend that photographic records be made by owners of unique and valuable property which may be stolen; many insurance companies follow this practice.

Photography offers the ideal way of graphically portraying the scene of crime, and sometimes in rare instances the crime itself. The modern investigative agency provides for routine and efficient photography of the scene of action in murder cases, assault, certain robberies, automobile accidents, and the like Such photographs become invaluable in a subsequent study of the crime and a re-accounting of the action before the jury or persons not familiar with the scene They become most useful at times in the interrogation of suspects and of witnesses, when they are not only valuable as a pictorial reproduction of the situation for reference pur poses, but sometimes act as a surprise inducement to confessions when presented to the criminal who up to that point has reassured himself that the action of the commission of the crime is unknown because there were no eve witnesses at the time of its commission

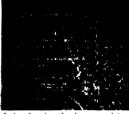
Particularly graphic in this latter re spect are those rare photographs depict ing the commission of the crime itself. Several instances of this kind have come

to the attention of the Federal Bureau of Investigation A photograph in the collection of a Larkspur, California, citizen depiets a stagecoach holdup reported to have taken place at Aliwahnee, California, in 1901. The picture clearly shows the robber dominating his victum and is said to have been taken by one of the passengers on the coach. Another such picture resulted when a storkeeper sulted when a storkeeper as to freeze. of St. Louis, Missour, after being the victim of a number of burglaries, arranged an automatic camera system equipped with flashlights, whereby he is reported to have been successful in obtaining an excellent photograph of a burglar following entry into his store, the picture subsequently receiving some

prominence in the national press Still another such photograph involved the use of a home made affair by means of which a vagrant was automatically pictured when he opened a refrigerator door which was on the porch of a citizen's home in a Maryland suburb of Wash ington, D. C. The latter case is particularly interesting in that this same photograph was the means of identifying the thief-when his body was found a few weeks later after having been struck by a railroad train-as a criminal with a previous police record.

There are frequently in

perpetrator can be identified is indeed a rich prize, but, so far, success has been rather infrequent With further improvments in the manufacture of photographic equipment and film, and possibly with the utilization of infra-red light, greater success may follow Ultimately, perhaps, photographs of marauders will be ob-



Section of a piece of carbon paper, photographed under slanting light, reveals message

Blood spots on a blue cost, invisible to the unsided eye, were brought out vividly when the clothing was photographed



Two examples of pictures taken with concealed cameras, without the knowledge of the subjects pictured Such photography may be of great assistance to law enforcement men

use today secret automatic cameras de signed to take photographs of criminals committing an unlawful act With the highly sensitive film emul sions now available, these devices would seem to have some value if the actuating means of operating the camera is a practical one Such cameras have been reported as installed in theater ticket booths where the overhead canopy lighting is favorable, and in institutions where, because of the existence of large sums of money, attempts at robbery are anticipated A good photograph of a criminal act whereby the tained in pitch darkness. The miniature camera is also used to advantage Can did shots of the criminal or of his activities are sometimes made. In this work such accessories as the telephoto lens and right angle view finders are often helisful.

Occasionally a photograph, instead of placing the person charged at the scene of crime, may be used

by the defense to show that the suspect was not at the scene of crime Such photographs were important in a case some time ago: pictures showed the accused with other persons at a location a long distance from that where the crime took place. These pictures also recorded an event, the time of which was identical with the time of the crime Pictures of this latter kind are usually made for some other specific purpose. Frequently, however, details are recorded in the photograph which later become valuable in an inquiry or controversy which may be quite unrelated to the original object of making the photograph and without any intention on the part of the original photographer to have included the incidental information. In this respect photographs are frequently more valuable and complete than the recollection of an individual concerning what he visualized at the time, especially when his attention during the time in question was not necessarily focused on the subject of later discussion.

There was a time when photographers would often say: "What you



Left. An example of orased writing that was made visible by photography with ultraviolet. Below, center The lettering on a leather has was removed to as to be invisible to the unaded eye, yet shows plainly when bag is photographed by infrared Below, right Upper picture show a serial number that was changed; lower picture, show the property of the p

be teadily restored by means of photogeraphy. Sometimes the sub-pigment is worn from the surface so that no evidences of it appear, yet it may be found below the surface by infra-red photogeraphy. A particularly good illustramoney bag, on the surface of which could be seen no writing, an infra-red photograph graphically disclosed the name of the bank from which it had been stolen

X ray photography in the Laboratory is sometimes used to disclose the contents of suspicious packages. The application of X-rays and photography for the determination or identification of materials is also usable. X-rays will disclose many kinds of hidden objects on the shores or clothing of a prisoner Objects swallowed by persons, or buildets in the bodies of victims, are clearly disclosed through use of the X-ray.

The technical testimony of the laboratory witness in court nearly always is supported by photographs Frequently he prepares large photographic charts in which the fingerprints, the handwriting, or the bullet markings are magnified many times so that the jury can clearly follow his exposition of the identification. An additional advantage of this procedure is that the photographs are introduced in evidence as official exhibits. They thus become a permanent record of the case and may be taken into the jury room where they are of considerable assistance to the jury in reaching its verdict

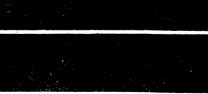
In order to complete the story of photography in crime detection we must not omit its importance in police training. The Training Division of the FBI.

can't see you can't photograph." In the Scientific Crime Detection Laboratory this adage is certainly a fallacy. Over and over again the camera is utilized to produce a record of that which cannot be seen with the unsided eye. In the Technical Laboratory of the Federal Bureau of Investigation at Washington. photography is an all-important part of the routine handling of cases submitted for examination An "object shot" is made of every piece of evidence submitted to the Bureau's Laboratory for examination This constitutes a valuable record in the files of the condition of the evidence upon receipt. It furnishes the possibility of secondary evidence in the remote event that the original evidence may become damaged or deteriorated. It is used at times in court to establish positively that the original article then in the court room is the same one which was examined in the Bureau's Laboratory at some previous time

DURING one stage of the chemical development of latent fingerprints on paper, fugitive iodine fumes are utilized. If good, readable fingerprints are thus found, they can be recorded only by photography for they soon disappear from the paper. This is done in the FBI Laboratory by means of a fixed-focus automatic timing camera which produces a picture of the document with the fingerprints thereon at exactly 10 1 size.

Special photography is essential in the examination of many problems involving questioned documents. Chemical erasures are detected, and the original inal writing before erasure made read able, by photography in ultra-violet illumination Hardly noticeable indentations in the paper caused by the pressure of pen or pencil perhaps on another sheet are made plainly visible through photography utilizing special side lighting which throws the hills and valleys of the paper into sharp relief. Special photographic methods have been devised for producing a readily readable photograph of the impressions left on carbon paper Ink strokes which anpear to the unaided eye to be the same





color and kind can sometimes be definitely segregated due to their different effects on the photographic plate.

Photography with infra-red illumination produces other results. Writing prepared with an ink which is opaque to infra-red, and subsequently obliterated with an over-layer of another kind of ink more transparent to the red rays, may which includes the FBI National Police Academy, is fully equipped with every modern apparatus for visual education. Sound motion pictures, projection alides in color, and large photographic charts combine to provide in a few weeks or months of concentrated training the experience of veterans of many years service.

A Bridge That Floats

THE world's most remarkable high way bridge--with a floating portion 6561 feet long made up of huge con crete and steel pontoons which carry a four-lane express highway-is now the center of engineering interest in the Pa cific Northwest. It is part of the Snoqual mie Pass East-West highway across the Cascade range where that highway en ters the city of Seattle, on the shores of Lake Washington. This great eleven-unit bridge-highway project runs from the southern heart of the Seattle business district for six and one half miles due east, directly across the middle of the beautiful lake which bounds Seattle on the east, on across Mercer Island, and

thence to the mainland. Work on the project is being speed ed to have it ready for the rush of summer tourist traffic by July first of this year.

The bridge project is cost ing \$8,854,000. The Washington State Tollbridge Authority, which public body is also constructing the Tacoma Narrows suspension bridge, is the developer of this project. The State Highway Department let a contract on November first for a nine-mile stretch of fast, four-lane, arterial highway that runs directly east toward the mountain town of Issaquah. This stretch is at the eastern end of the bridge project.

The two projects—the bridge and the above-mentuoned atretch of highway—
chop nine miles off the total
distance between Sinoqualmie
Pass and Seattle, eliminate 65
percent of the curvature and
50 percent of the rise and fall,
and save an hour for passenger cars and two hours for
trucks on the mid-state high
trucks on the mid-state high

way to the east. For 25 years, local people dreamed of a way to cross Lake Washington with a huge bridge and avoid the twisting Seattle-Cascade route through Renton, at the southerly end of the lake, and out the rough wooded footbills and canyons. The lake is 20 miles long and runs along the entire eastern boundary of Seattle between the city and the Cascade range. Lake Washington Canal, for deep-water ships, connects the lake with Puget Sound. Even at Seattle's famed Seward Park Peninaula, where the lake is narrowest, the cost of a bridge would be

Four-Lane Highway on Monster Pontoons... Over a Mile Long... Tied By Cables to Great Anchors in Bottom Mud... Safe, Vibrationless, Permanent

By CHARLES F. A. MANN

fantastic and too far south of the needed traffic route into the city's downtown shopping area.

It would cost between \$35,000,000 and \$50,000,000 to build a suspension span across the lake itself, and there was no precedent for such a bridge because no puers have ever gone down to 400 feet

The state of the s

A recent air photograph of the Lake Washington Bridge showing work progress. "Gate" span will be near gap

below water level. Pier footings would, in fact, have to go much deeper than that Lake Washington, only a few feet above the level of Puget Sound, is very wide and deep. The water varies from 150 to 200 feet deep, and the bottom is soft mud for over 100 feet below that. Jet borings have gone down into this mud nearly 325 feet below that upon the lake, but there is nothing firm enough on which to rest a giant bridge Such deep piers were, therefore, out of the question.

Engineering research on this problem

finally centered on the present route as the best, and a pontoon bridge was decided upon. The decision sprang, not from desire or design, but from simple necessity Conditions were favorable for the construction of a floating structure There is no current or tide and only a allow seasonal variation of three feet in

the water level The lake water is fresh so that it would not deteriorate a floating concrete structure. No ice of any consequence forms on the lake in winter Finally, the mud of the lake bottom would provide a strong foothold for heavy anchors which would hold the bridge in place with huge cables.

FOR a long time after the decision was made to construct the bridge in this fash ion, immunerable questions were directed by Seattle cutizens toward Mr. Charles E. Andrew, Chef Engineer of the Lake Washington Bridge They wanted to know shy a concrete pontoon was to be used, and would it sink in a storm, and what holds the pontoons together?

Even the Seattle news papers were so puzzled that they condemned the project editorally as technically im possible. They were sure the whole thing would sink in a storm As layman, they can the excused for their bewil

dered attitude for this will be the first bridge of its kind ever bull anywhere in the world. It is true that there are pon toon bridges across the Rhine at Coblenz, across the Golden Horn at Istanbul, and at Ebrie Lagoon, Ivory Coast, French West Africa—but these are simply bridge decks built across floating boat-shaped pontoons anchored like acrows The only other concrete pontoon bridge is now being constructed at Hobst, Tasmania.

The key to the six and one half mile project is the lake crossing of 7800 feet. At each end there is a low steel truss span, a heavy steel transition span, and a novel floating "gate" on the Mercer laland side This gate opens the structure to provide a clear 200-foot channel to allow the largest ships to pass. The end span system is of ample clearance (30 to 38 feet, with water depth of from 45 to 60 feet) to take care of 95 percent of the lake boat traffic, including tugs, and the floating drawspan will amply care for all the rest.

The Boating section is 6561 feet in length, made up of 10 identical middle-section pointonns, and 12 of special shaper. These special ones, with but sight variation in design, are used at each end in connection with the transition (ferry-slip type) spans and the ship lock on the Mercer Island side Principal or typical, pointons are 349 feet 10 inches long, 59 feet wide, 14 feet six inches deep Each is made of dense concrete and slightly under 350 tons of closely spaced reinforcing steel bars % of an inch in diameter. This steel is placed in all walls, bottom top, and rail-

Each pontoon weighs 4558 tons, and normally floats about seven feet two inches deep in the water. The unusual feature of this construction is the utter simplicity. The outer walls of the pontoon, the bottom slab, and the roadway slab on top are eight inches thick, while the entire system of inside compartments and the end walls are six inches thick The interior of each typical pontoon section is divided into 96 cells of about 14 cubic feet each. Each strip of four cells across is connected by openings to another strip of cells, making eight cells in each of 12 water-tight compartments. any three of which can be injured and flooded without disruption of traffic due to lack of buoyancy

The roadway slab, which carries a



Sketch of draw span through which large ships will pass. The postoon between the guard "wings" will be pulled back into the "U" of the section at the top

four lane, 45-foot roadway, 24-foot side walks, and a three foot concrete guard rathing on each side, is integrally a part of the pontoon. For each 53 tons of load on the roadway, the pontoons sink into the water one inch. Thirty passenger autos on one pontoon would just about add enough weight to sink them down a mere inch!

THE loading capacity of the floating section is figured for a 90-mile wind plus four lanes of 20-ton trucks, humper to humper Thus the factor of safety is adequate because such a combination is unlikely. Should it occur, the pontoons would sink about 22 inches into the water Obviously, the total weight of each pontoon is so great in proportion to any possible load that a 50 percent capacity load driving down one side of a pontoon in a high wind would cause so little vibiation and movement that a nedestrian could easily imagine that he is walking on a highway on solid ground A six foot wave height has been provided

for by making the railing three feet above the sides of the structure, or nor mally 10 feet above the waterline

Transversely, through the middle of each pontoon, runs a cable channel and racking mechanism, in a steel beam channel, that carries the ends of two 234 inch steel cables into the side of the pontoon These cables run up on a low angle from flat, umbrella-shaped concrete anchors, sunk by water jets into the soft lake bottom, to the racking mechanism inside the middle of each pontoon Hydraulic jacks can be quickly lowered to rack these cable ends back and forth to take up or let out slack to compensate for seasonal variations of the lake level A movement of 12 feet has been provided for, and their peculiar method of connection with the pontoon prevents, or rather acts against, any tendency of the pontoons to rock in a storm. The cable sad dles literally he the pontoon to the lake surface and exert a downward pull The wing-type anchors are 26 feet wide and 14 feet deep.

Each of the pontoon sections is connected to the adjoining pontoon in an unusual manner Around the top, bottom, and sides of each end runs a row of huge three-inch bolts, 54 in all, that run through steel tubes imbedded in the con crete end-walls A double nut locks them securely A soft rubber ring, located a round the outside ring of bolts, is squeezed water tight when the pontoons are bolted together. The remaining space between the pontoon ends - slightly over one inch-is unwatered and grouted with dense cementsand mixture. A third avetem of shear-stress between pontoons is provided. This consists of two three-foot-



Sketch showing section of one pontoon and manner in which a single pair of cables is attached to the middle of each pontoon and to heavy anchors in the mud on each side



Lowering one of the immense anchors, the size of which may be in dicated by comparison with the men

square concrete plugs, or keys, project imp into the adjacent pontion 12 inches Thus with these concrete shear keys, the 54 three-mich bolts, and the continuous ring of cement grouting, the entire floating section becomes one entire floating section becomes one continuous concrete monolith, with any two pontions capable of sustaining a completely floaded middle pontion until any possible repairs can be effected in such a case traffic would have to be thunned out, of course

And, say the engineers, nobody knows just how much "bend" or "give" there is in a mile and one-fifth of concrete ribbon, but it is estimated to be several feet, particularly because of the dense steel reinforcing system used in all the walls.

NO painting, or any other repair expense will ever be necessary. The steel anchor cables rest in fresh water, see and away from the arr Slighth seepage may occur in a faulty panel, but a portable pump outfit can keep the birdge bailed out. Once a month the birdge bailed out. Once a month the manhole covers—12 on each pontoon will be lifted and the interior inspected it is estimated that about 100 gallons of water per year will seep into the entire birdge, and this is less than normal "creep" of water up the walls and onto the toof, or hughway deck, slabs'

Even if all the rubber sealing gaskets give way, the concrete grout extending to within eight inches of the outer rim will keep all water out of the bolt-holes and away from the end compartments

It is claimed that this is one of the most remarkable pieces of concrete construction ever attempted Approximately 2110 cubic yards of concrete will go into each pontoon.

On Harbor Island, Seattle, 16 miles from the bridge site, a pair of graving docks was built especially to construct the pontoons One graving dock is 70 by 35 by 15 feet deep and the other is the same width and depth but is 400 feet long. Steel tide gates are placed at each end. The concrete bottom slab of each dock is floored with wood which makes the bottom form of the pontoon's bottom slab Concrete for the pontoon bottom is poured on this after the steel mat is land After a few hours delay, the interior cell walls, three longitudinal central walls, two outer walls and 25 transverse walls are made in one contration with the contraction of the contraction with the concrete very dense around the steel renoring wire Finally, the top slab is poured after the cell forms are removed. All forms are removed.

Four and one half days from the time the deck slab is poured, the end gates are raised and the graving dock flooded so that the pontoon is simply floated out to be towed by two tugs to the bridge site 16 miles away After all pontions are assembled, deck railing and sidewalks and curbing will be poured, and electric lamp posts set

The entire project begins on Rainier Avenue in Seattle and runs through twin two.lane self-ventilated tunnels under Mt Baker Ridge a distance of 1400 feet from portal to portal. Thence it goes down to the lake on simple truss spans and one 215-foot arch span to the novel transition span mentioned before This span permits movement between the rigid portions of the bridge up and down and sideways to compensate for changes in the lake level, traffic load, misalignment of piers due to wind pressure, and wave action. From there the highway crosses the first 15 floating concrete pon toons and runs to the draw-span located 1500 feet out from the Mercer Island shore

At that point, a 378-foot movable pontoon section can be telescoped into a "U"-shaped section to give a 200-foot clear channel for ships Special steel buoyancy pontoons will be floated under the "U" arms to compensate for the extra weight of cable drums, motors, and heavy steel track for the floating and heavy steel track for the floating

movable section Two 75 horsepower, geared motors will work the cables that move the floating draw-section Each half of the "U" pontoons (a forked pontoon and two narrow side pontoons) will carry a two-lane road Anchors at the sides, as well as fore and aft, are provided here to carry the extra stresses.

East of the draw section will be an other transition span, another arch span, and the approach spans On Mercer Is land will be an eight-lane tollgate. The tolls at this gate will be about 25 cents for each passenger car plus five cents for each passenger, and for trucks it will be from 50 cents to \$3.50 each

THE Mercer Island end of the project consists of a four-lane express highway, with under- and over-pass for local island boulewards and an approach road on both isdes Between Mercer Island and the East shore, two major sections are necessary The first is a truss and East Channel span 215 feet long, with a clearance of 39 feet and a total length of 1360 feet. This is followed by a 2000-toot inghway section and then a 2000 foot concrete viaduct across Mercer Slough

So long and involved was this project that it was split into eleven units, each under a separate contract Nearly twenty large Pacific Coast Contractors are engaged in rushing this complicated project through in time to meet a PWA deadline of July 1, 1940.

The Lake Washington Bridge is being built by the Washington Tollbridge Authority, headed by Lacey V. Murrow, Director of Highways Charles E. Andrew, R. B. McMurn, Admiral Luther E. Gregory, and R. H. Thompson constitute the board of consulting engineers, with Mr. Andrew as chairman Mr. Andrew is, in fact, in charge of both the Lake Washington and the Tacoma Narrows Bridges Mr. G. A. Gregory is project engineer and L. R. Durkee is the resident engineer inspector for the PWA.



Pontoon end, showing shear blocks and holes for bolting (with three-inch bolts) to the next unit. Cement grout and rubber ring around bolts provide a seal

AIR. WATER, COAL = HOSIERY

TOR many years the du Pont Company has carried out research directed to the improvement of existing products and the development of new products, but it was not until early in 1928 that "pure" or fundamental research was started. Whereas the "applied" research previously carried out was directed to immediately practical ended, the "pure" research begun by the Chemical Department some 10 years ago was designed primarily to develop fundamental information about chemical products and processes, with no thought that the information developed would be of immediate practical value.

The first study undertaken in connection with this fundamental research program was directed to a better understanding of how and why certain of the tiny building blocks or molecules, of which all matter is made, unite to form "mant" molecules such as those found in rubber, cellulose, and resins Chemists have long been vitally interested in this subject of giant molecules, tech nically known as superpolymers, and in learning everything possible about the mechanism of what the chemist calls polymerization, which, after all, means only the process by which large molecules are formed from small molecules Such information has a two-fold value First of all, it satisfies the chemist's inherent currosity about the constitution of matter He wants to know, for example, what rubber is and why it stretches, and why the cellulose of cotton is in the form of long fibers

An understanding of such processes

Fiber From Abundant Raw Materials . . . Fiber is Only One of a Large Family of Chemical Products Known As Nylon . . . Research That Led To Them

By H. T. RUTLEDGE

as polymerization also enables the chemist to direct certain of the forces of nature along desired lines, one result of which is that he is able to make things which nature failed to provide. It is, indeed fortunate that man is endowed with this misatiable curiosity

concerning the things which surround him, since it has been through his efforts to understand these things that he has been able to master his environment. Out of the study of polym-

erization begun by the

Chemical Department in 1928, fundamental information of much academic importance was developed. It is was demonstrated, for example, that certain small molecules could be made to unite in such a way as to form guant molecules of great length — so-called linear superpolymers, the small molecules being joined together end to under superpolymers and molecules being joined together end to end somewhat like a chain of ordinary pa

per clips

As yet this information was only of interest to chemists who wanted to know more about how matter is built up from the tiny molecular building blocks, but after this fundamental research had

been under way for about two years, something happened which was destined to be of far-reaching practical value. In attempting to remove a sample of a molten long-chain superpolymer from the still in which it was prepared, one of the research chemists engaged in this

study noted that the molten polymer could be drawn out in the form of a long fiber; somewhat like that of silk. He noted also that, even that the silk of the could be further drawn to could be further drawn to several times its original length. Such a phenomenon had never before been observed.

While this original fiber was not very strong or elastic and, in addition, was softened by hot water, it, nevertheless, suggested the possibility that some related type of superpolymer might give fibers which would possess the characteristics desired for use in textiles Further research was accordingly under taken, directed to the synthesis of a superpolymer from which strong, clastic, and water-resistant fibers would be drawn or spun This particular research was, of course, of a very practical nature, and we shall not here follow further the fundamental research on polymerization which, however, was continued and is still being carried on.

DRACTICAL research directed to the synthesis of a superpolymer from which fibers could be drawn suitable for textile purposes did not bear immediate fruit. Many difficulties were encountered. Numerous superpolymers were synthesized, but some of the resulting fibers were deficient in strength and elasticity, while others, although sufficiently strong and elastic, softened at quite low temperatures, or were sensitive to water. In other words, they did not possess the properties required of a textile fiber The outlook at one time was so dark that consideration was given to suspending this particular line of applied research. But finally a superpolymer of a different type was prepared, known as a polyamide, from which fibers that were spun by hand



Aerial view of the new nylon yarn plant near Seaford, Delaware, which started operation in December Production will shortly be 3,000,000 pounds a year

were found to possess such characteriatics as to warrant extraordinary efforts to bring the development to commercial

Much work was yet to be done, howver, between that day when the first polyamide fiber was extruded through an improvised spinners made from a supment of nylon by du Pont. Hundreds of different polyamides had to be synthesized before superpolymers having not the desired characteristics were found, it was then necessary to investigate sources of raw materials for the intermediates needed in making these superpolymers, and to devise practicable processes for making these intermediates

BUT panntaking study, together with the "patient money" necessary for successful research, finally won out, and on October 27, 1938, du Pont announced to the world the development of a group of new synthetic superpolymers from which, among other possible applications, textile fibers could be spun surpassing in strength and elasticity any previously known textile fiber, whether cotton, linen, wool silk, or rayon.

Nylon is the generic name chosen for the synthetic linear superpolymers developed in connection with the research just outlined Nylon is officially and scientifically defined as "a manmade, protein-like, chemical product [polyamide] which may be formed into fibers, bristles, abeets, and other forms which are characterized, when drawn, by extreme toughness, elasticity, and strength."

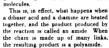
Note that nylon is a "protein-like chemical product." This means that it has somewhat the same chemical composition as the proteins, of which silk, hair, and wool are common examples Nylon does not, however, have an exact chemical counterpart

in nature, and fibers made from it cannot, therefore, properly be referred to as "synthetic salk," although resembling silk in certain respects The synthetic material — or rather, family of materials — known as nylon is not only new, but different from any existing natural product.

Again, nylon "may be formed into fibers, bratels, sheets, and other forms." From this definition, it follows that ny-lon does not refer simply to the fibers or yarm spun from a polyamide, as many; thought, but rather to the polyamide itself from which fibers, bristles, sheets, and the like, may be formed. The term "nylon" does not refer to any particular form of the polyamide any more than does the term "glass" refer to any particular to more in the signal of the signal of

rather to a family of related compounds: the polyamides, of which there are many members

The superpolymers of the nylon polyamide family can be made in several different ways One of the simplest involves the reaction of a dibasic acid, of which there are many, with an organic diamine, the two hooking together in chains This reaction, which results in the formation of relatively small molecules, is followed by heating to bring about the union of many of these small molecules to give the giant polyamide



Since a product formed in this way is a polymer, long-chain polyamides are also spoken of as superpolymers. The polyamide superpolymers made from a dibasic acid and a diamine are known as nylon

Though it was indicated above that the polyamide chain might be infinitely long, in actual practice, those in nylon, by proper control of the reaction, are purposely limited in length in order that the nylon may have desired physical qualities for proper mechanical processing of different types

Since there are dozens of different dibasic scids, diamines, and the so-called amino-acids, as well as other compounds which may be used in making polyamides, it follows that many different types of nyion are possible.

only 10 different dibasic acids and 10 different diamines, it would be possible to make 10 times 10 or 100 different nylons. Actually, by inter-polymerization of various dibasic acids, amino-acids, and diamines, thousands of different nylons are possible; for example, one dibasic acid could be made to react with two different diamines at the same time, and in varying proportions, or vice versa. Also, two or more different nylon polymers might be blended to give a composition different from that of the parent nylons. It should be apparent, therefore, that an almost unlimited number of nylons are possible - with different melting points, solubilities, and so on. Some, for example, might be quite flexible, while others would be stiff or rigid.

Since nylon is not one particular polyamide, but rather a family of re-



These "blenders" contain nylon chips about to be transformed unto varn for various textiles

lated polyamides, it might be expected that various raw materials could be used in making various types of nylon. and such is the case. One particular type which now appears quite promising for making textile yarns can be made from a dibasic acid derived from phenol, and a diamine likewise derived from phenol Oxygen from the air is also needed in making the dibasic acid. and ammonia is used in making the diamine Since phenol is commonly derived from bituminous coal, and since ammonia is made synthetically by causing the hydrogen from water to unite with nitrogen from the air, it follows that this particular nylon is derivable from coal, air, and water Other raw materials might, however, be used to advantage in making other types of nylon For example, one type which has been found useful for certain purposes involves the use of a dibasic acid derived from a vegetable oil It is thus evident that agricultural raw materials as well as mineral raw materials may enter into the manufacture of nylon.

W/HILE it is of economic and industrial significance that nylon can be made from domestic raw materials such as coal, air, and water, of which this country has an abundance, this is only a part of the story. The layman may sometimes wonder why a product based on cheap and abundant raw materials should not itself be "dirt cheap. He frequently fails to appreciate that, in order to make a product such as nylon from "coal, air, and water," many intricate chemical reactions must be carried out, involving elaborate and costly equipment, with rigid control at each and every step of the process.

and every step of the process.

The most interesting physical property of nylon is that it can be cold drawn. If a fiber of nylon which has been made under low tension is subjected to further tension, it can be drawn to from four to seven times its original length, decending upon the particular.

polyamide being used in that type.

A highly interesting phenomenon occurs during this stretching operation.

The long, chamble molecules which make up the undrawn fiber are arranged in a helter-skelter fashion like the individual straws in a haystack but, or drawing this sher to several times its original length, the long-chain molecules take on an orderly arrangement. They become parallel to one another.

This peculiar behavior, known to the chemist as "orientation" of the molecules, is more than just an interesting phenomenon, for on this property hinges the very important industrial value of nylon. The practical significance of this property, particularly as applied to text tide fibers, is that, on cold drawing, nylon becomes exceedingly strong and elastic. One might think it is originally leastic, since it can be stretched to several times its initial length. But class text with means more than "stretchability."

THE degree to which a stretched ma length is a measure of true elasticity. A piece of warm molasses candy, for example, can be stretched to great lengths but it isn't elastic, it will not spring back. Similarly, if a nylon fiber, made under low tension, is stretched to, let us say, double its original length, it will not spring back, but will remain double its original length If however it is drawn to some four to seven times its original length, depending upon the type of nylon, it becomes truly elastic, with the result that, if it is stretched farther, it does spring back not, of course, to its original length before being stretched at all but to the length it had when it assumed the property of true elasticity. Even if kept stretched for days, the oriented nylon fiber does not lose its high degree of elasticity

Drawn nylon fibers possess not only a high degree of true elasticity, but also



Durable and sanitary, nylon bristles are here being used to wash bottles, one of many uses

great tensile strength. Nylon can be drawn into fibers which, for a given size, are stronger than corresponding fibers of cotton, linen, wool, silk, or rayon. The superior strength of drawn nylon is due in part to the fact that the long, oriented molecules lie so close together as to give rise to powerful intermolecular forces which resist slippage of the molecules when tension is applied Breaking of any material is due only to separation by force of the mole cules that make up the material, and closely packed, parallel molecules like those in drawn nylon offer great resistance to separation

Another factor which contributes to the high tensile strength of drawn nylon is the extreme length of the molecular chains in a nylon filament. Just as a thread made from long cotton fibers is stronger than a corresponding thread made from short cotton fibers, so is an individual filament made up of long includes stronger than a similar filament made up of short molecules Although the molecules.

nvilon are spoken of as extremely long, they are long only in comparison with ordinary molecules. Actually, the 'extremely long' molecules in nvilon are only of the order of 10 or 12 millionths of an inch in length—

too small to be seen even through a microscope

It is the combined strength-elasticity factor of drawn nylon which causes the yarn to lend itself so well to the manu facture of fine housery. Neither strength nor elasticity alone would be sufficient. Until the development of nylon yarn, silk was the only textule fiber which possessed the combined strength and elasticity demanded of a yarn for fine hossery, but from nylon it is possible to spin yarn having a strength-elasticity factor superior even to that of silk.

Oriented nylon is also extremely

tough It is this property, among others

which causes the "bratles" made from relatively large, oriented nylon filaments to be well suited for use in many types of bratles. It is like-use this quality of toughness which causes fishing lines of nylon to wear so well. They are not only strong and elastic, but highly resistant to fraving, that is, they are unite resistant to abrasion.

Nylon, in common with other crystalline materials, has a fairly sharp melting point, the temperature depending, of course, upon the particular nylon. Some of the nylons melt at quite low temperatures, while the melting point of others may run as high as 600 degrees. Fahrenheit, or even higher The meltung point of the type which now appears suitable for textile purposes is about 480 degrees, Fahrenheit, which, fortunately, is about the temperature normally used in ironing fine fabres.

ing fine fabrics Fabrics made from the commonly used textile fibers will of course, blaze when brought into contact with a hot flame, unless specially treated to make them flameproof. Fabrics made from nylon varn, however, do not blaze when brought in contact with a flame. The nylon fabric simply melts and, although the malten nylon is ultimately consumed if kept in the hot flame, the fabric itself does not blaze and propagate flames. Nylon of the type to be used in textiles is not injured in the least by water or any liquid commonly used about the home, such as dry-cleaning fluids. It is attacked only by certain chemicals. such as phenol (carbolic acid), and certain mineral acids which are normally found only in the chemical lab-

oratory. Furthermore, nylon fibers are substantially as

strong when wet as when dry
Nylon fabrics are at least
equally as resistant to indoor
and outdoor light as are corresponding silk fabrics. Nylon fabrics undergo no ap-

preciable deterioration in the absence of light, and may accordingly be stored for long periods of time without injury. They are proof against attack by moths as well as by fungi. such as those responsible for mildew

Because of its good insulating properties and high abrason resistance, experiments are now being made looking to the use of hydro coatings as insulation for the wires in various types of electrical machinery and apparatus. For this purpose the wire is not simply wrapped with hydro yarn, but is encased in a continuous film applied from motion raylon polymer.

As made ordinarily, nylon in the massive state — that is, in relatively large pieces — is opaque, but the massive state in the property of the

One of the most promising outlets for nylon will be in the manufacture of yarn for fine hoseivy. The properties of nylon yarn are such, however, as to suggest its use for a wide variety of textile purposes, particularly where a high degree of atrength and elasticity are essential Among the possible textule applications for nylon yarn are knit goods of various kinds, woven dress goods, lace, bathing suits, underware, upholstery material, and the like. Nylon yarn is now inding commercial application in the manufacture of sewing thread and fishing lines, but only in a limited way

A highly specialized possible application for nylon yarn is its projected use in making parachites, including both the fabric and shroud lines. Hitherto, these have been made from silk, only

"Exton" bristles made from nylon have been used on a rather large commercial scale as the bristling filaments in the Dr. West, "Marale-Fuft" look brushes. Bristles made from nylon have been introduced commercially into various other types of toulet brushes, in cluding hair, anal, clothes, hai, and complexion brushes as well as in many types of mudistral brushes. Since playing the size resistant to chemicals, oils greaces, and other destructive agincies, they are well suited to many industrial annihealties.

Since one of the major outlets for nylon will be yarn suitable for hosiery and other textile purposes, the process by which nylon yarn is made is of particular interest.

THERL are two major processes, which may be used in spinning mylon yarn. Nylon polymen may be dissolved in a suitable solvent, such as a phenol. and while in solution forced out through a spinneret into a bath which would remove the solvent and leave behind the tips, solid nylon filaments. A spinneret quite similar in general design to that used in making rayon may be used, that is, a cup with as many fine holes in the bottom as the number of individual filaments, designed in the yard.

The method now being used is, however, quite different. The nylon in modten form is forced out through a spin neret by a suitable pump. As soon as the filaments strike the cool air outside the spinneret, they instantly freeze—that is become solid.

The hlaments from one spinnerer are wound up on a suitable device and later given a twist of a few turns per inch to facilitate further handling. The process from this point on involves stretching the bundle of fibers, now known as yarn, to the deared degree, applying a "size" or lubricant, ot both to facilitate knitting or weaving, and peakaging the yarn in the form of akeins, "cones" or other forms suitable for shunding.

As normally made, nylon yarn has a



Nylon yarn being processed. Machines twist the bundle of slender filaments for

high fusier but by adding a finely divided white pigment to the molten polymer before it is spun, yarn of the desired degree of dullness may be objunced. Since this dullness is due to pigment particles eithin the filaments, and not simply on the surface, the dullnessies not affected by wear or by washing.

In the same way, colored yarns may be had by incorporating suitable pig ments with the nylon prior to spinning for the most part, however, nylon yarn-and innshed fabrics will be deed in the usual way after the yarn is spin or the fabric kanted or women Fortunate ly, nylon yarns and fabries take a wide sartest of deep.

In its Trade Practice Rules for the Rayon Industry, dated October 26 1937, the Federal Trade Commission defines rayon as follows

"The word rayon is the generic term for manufactured textile fiber or yarn produced chemically from cellulose or with a cellulose base."

Since uslon is not produced chemically from cellulose, nor does it have a cellulose base at follows from the above official definition that nylon yarn can not properly be considered as a type of rayon. Furthermore, the properties of textife fibers and yarns made from rolon are quite different from the properties of any existing type of rayon particularly as regards strength and elegated.

A plant for the commercial manufacture of invlon yarn, errected by the du Pont Company at Seaford, Delaware, went into production on December 15 last, in addition, extensions are being made to the du Pont Ammonia Depart ment plant at Belle, West Virginia, to provide facilities for making nylon intermediates. The initial plant at Seaford will have a capacity of approximately 3,000,000 pounds of nylon varn per year. Nylon polymer for monofilament purposes (bristles, surgical sutures and so on) as well as for other possible applications, will also be produced at Seaford. The nylon development will provide employment initially to a about 1000 persons.

NILON hosiery will be made by a number of nationally known hosiery manufacturers and it is anticipated than pylon bosiery for both men and women will be put on the general market by late spring or early summer of 1940 Nylon varn will be made in several different sizes, and hosiery will be available in various weights, ranging from light sheer to service weight. No special precautions are necessary in laundering nylon hosiery. Indeed, no more care is necessary in the case of nvlon hosiers than with other fine hosiery of the same weight. Nylon hosiery knitted in the orthodox manner will, when a thread is broken, run just like any other fine stocking so knit. Since, however nylon varn has a high strengthelasticity factor, nylon stockings should be less hable to runs than other highquality stockings of the same knit

The manufacturers say that the word "mylon" has no significant deriva-tion; that it was selected as a generic name because it is non-technical and says to pronounce, its individual letters do not stand for anything. Yet that simple, counced word has taken on a no bility unequalled by any other, at least no so short a time. It represents enormously significant achievement. And it should become a symbol of that exploratory research which starts with no practical end in view but results so often in new products that enrich man's life and help to further civilization.

STOPPING TIME

W/ITH microscopes and telescopes, which is a conquered space, making it possible for man's feeble eyesight to piece the mysteries of things unmagnably small or far away. And now, much later than these instruments, seemee has developed another, the modern stroboscope, which freezes the swiftest motions while they are still going on, and seems able to stoo time tieffel.

In the laboratory of Professor Harold E. Edgerton, at the Massachusetts In stitute of Technology, one can see time not only arrested but practically hand cuffed. Here in a corner, for example, stands an ordinary electric fan. with the letters "M.T" painted on one of the blades. When the fan is turned on,

the letters quickly vanish, of course in a rapidly revolving blur And any layman would be willing to bet that the letters won't be visible again until the fan slows down and stops But Professor Edgerton aims at the revolving fan with what looks like a sort of searchlight framed in a black box. He turns a knob, and suddenly the letters re-appear on the fan, perfectly legible and stock still, although the blades are whirling furiously Another turn of the knob, and the letters crawl forward as slowly as the second hand of a watch Then uncannily they stop and begin to move slowly backward, contrary to the motion of the fan, which all this time has been revolving 1100 times a minute

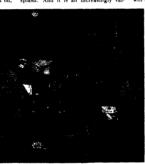
In the next demonstration of the handcuffing of time, the bright light from the black box is flashed onto a stream of water

which in ordinary light appears to be continuous in a moment the stream becomes a series of drops that stand still—queerly meshapen little jewels possed in midair. A turn of the knob, and they seem to climb back up into the faucet, delying the law of gravity. Now Professor Edgerton focuses a second flashing box on the water. Suddenly the top half of the water. Suddenly the top half of the stream drips down, while the lower half drips upward against gravity to meet it. The stream of water is composed of drops caused by pulses created by a small pump that circulates the water.

The stroboscope is not merely a toy for the creation of uncanny hallucinations. It is a very useful and important That is What "Whirling Watcher" Does . . . Newest Stroboscope is Light Weight, Portable . . . Allows "Stills" and Movies of Extremely Fast Movement

By ROBERT LITTELL

tool of science which, though the optical principles behind it have long been ended, and practical models of it long been been made, has only recently been fully like been fully like and the natural world, telling us things we would otherwise never know about how birds by, how drops of liquid behave when they fall or of liquid behave when they fall or splash. And it is an increasingly val-



A portable stroboscope is used by the Boston Gear Works to watch gear-grinding angle and check speed

nable tool of industry Thanks to the stroboscope, women's stockings are sheerer than ever before; guns will find their targets more accurately; there is less and less unpleasant and costly vibration in your automobile

The modern stroboscope is a device for producing extremely short flashes of very bright light at regular and controllable intervals of time. The stroboscope which Professor Edgerton shone upon the fan blade marked "MLT." produces flashes of light only five milliouths of a second long—five thousand times faster than a human wink. And by turning a knob and reading a dial, it can be made to flash anywhere from 600 up to 14.400 times a minute. Even

the rapully revolving fan blade, during such a super wink as few millionths of a second, will move only a few ten-thousandths of an inch. Now it the light is made in flash 1100 times per minute—just as many times per minute—just as many times per minute as the fan blade as revolving—the light will always catch the blade marked "MLT." at exactly the same spot, and the letters will not only become visible, but appear

to be motionless. And what are actually 1100 separate images a minute we see blended into only one because our eyes are able to retain the image of things for a brief moment after they have disappeared.

This peculiar ability of the human eye, which scientists call "persistence of vision," you can demonstrate for yourself by a simple experiment with a lighted lamp Close your eyes Then open them to look at the lamp only as long as it takes to wink Even after your eyes have closed again, the bright light of the lamp persists for the fraction of a second Now if the lamp can be turned very rapidly on and off, and you keep your eves open, persistence of vision will bridge the gaps of darkness between the flashes of light, and the lamp will seem to be continuously lit. This optical "afterglow" explains the magic pro-

glow" explains the magic produced by the stroboscope in Professor Edgerton's laboratory

By making the strobocope flash is little alower than the fan is turning, or a little faster, the image of the letters on the blade will seem to be moving forward—or backward against its own true motion. The trick of the two-way cascade of water-drops is done with two strobocopes—one flashing a trifle alower than the rhythm of the drops, the other a trifle faster.

The intensely bright and extremely brief flashes of the stroboscope's light have made it possible to photograph motion far too rapid for even the fastest camera shutter. Some of the startlingly beautiful high speed photographs taken by Professor Edgerton with the aid of the stroboscope are already familiar to the public They are now collected in his book "Flash," with lucid explanatory text by I R Killian Ir also of MIT Here one can see the slow death of soap bubbles, the squashing of a golf ball at the moment the club hits it, the eddies of smoke at the tip of a whirling propeller blade, the first shy ooze of coffee from between the tagged fragments of a breaking cup With his swift flashing light, Professor Edgerton has caught drops as they fell through the air-and discovered that they weren't streamlined, as had been supposed, but flat on the bottom and lacking the pointed tail. He has snapped milk as it splashed: and one of the pictures of the splash pattern, like a beautiful regal crown, is hung in the American Museum of Mod ern Art. He has caught birdshot as it left the shot-gun, flying somewhat like geese in a V, with the wads tumbling after it A series of his photographs, each taken with an exposure of one millionth of a second, shows what hap pens when a rifle is fired at an electric light bulb the bullet peeking out of the muzzle at a speed of 2700 feet a second, the first cracks in the bulb as the bullet nudges it, the bullet coming out the other side before the bulb has had time (about one six thousandth of a second t to collanse

QUCH photographs can be taken with D an ordinary camera In a darkened room, the shutter is left open, and the exposure is made by a single flash of the stroboscope's light, which, though incredibly brief, is equal to the light from 40,000 50 watt household bulbs Often, to take the picture at the precise moment desired, the flash mechanism of the stroboscope is tripped by sound For intimate snapshots of a bullet in action, the stroboscope is set off by a microphone at a predetermined position some distance from the camera. As the speed of the bullet and that of sound are both known, it is a comparatively simple matter, by moving the micro phone away from the revolver, to take a picture of the bullet at any given distance from the muzzle

More amazing even than these stills are the slow-motion movies which the stroboscope makes possible. In Professor Edgerton's laboratory I saw films in which humming birds flapped their wings as lazily as a crow. One could see how they used their wings like propellers with a variable pitch, one could study the mechanics of their hovering. their ability to fly straight up and down Slow-motion films of pigeons showed how the feathers open on the up-beat. I saw exactly how a cat, held upside down a foot above the ground, rights itself in a twinkling to land on all four naws. A snake put his forked tongue



Operation of a Pelton water wheel, and the efficiency with which the stream of water is thrown aside, can be studied by stopping action with a stroboscope

out and drew it in again in the tempo of the Volga Boatmen. I saw what no human eye was ever quick enough to see until the stroboscope put time into low gear — the quivering vibratipa of nouscles as a football player kicked the ball, and the huge temporary dent his foot made in it. Water flowed from a jug with the slow oiliness of glycerne, ligh-speed cutting tools stumbled and prixed as if lame, and the decline and all of a soap hubble when dropped to the floor was as stately as a chapter from Bornan history.

The slow-motion pictures of prize fights and steeplechases which we see in the newsreels are taken at about six times the normal camera speed of 24 frames a second, and then run through the projector at normal speed. But even this speed isn't nearly fast enough for making slow-motion films of hum ming birds, snakes' tongues, or the action of water bubbles. Ordinary movie cany resonarate by intermittent motion each frame is stopped short for a fraction of a second, just long enough to record the image admitted by a synchronously intermittent shutter If speeded up beyond a rate of several hundred frames a second, the film may tear or catch fire by friction, and the shutter will be open too short a time to let in sufficient light. This problem is solved in one way by a stroboscope synchronized with a moving picture camera from which the intermittent mechanism and the shutter have been eliminated The film speeds evenly past the open lens aperture at rates up to 2000 frames per second, while the nec essary intermittent illumination is supplied by the rapid, brilliant, regular flashes of the stroboscope focused on the subject to be photographed. What made the letters on the fan seem to stand still, here records on the racing celluloid an image so nearly instantaneous that the film, during one flash, does not move far enough to cause a blur. As many as 6000 pictures a second have been taken by reducing the size of the frames and using the alternating flashes from two stroboscopes.

Photographs taken at extremely high speeds, and projected in slow motion, are beginning to be used in industry for the analysis of rapid irregular movement. The stroboscope by itself can intention only when the motion to be observed is uniform and periodic. But when used in conjunction with this special moving picture camera, unsuspected phenomena often appeared phenomena often appeared phenomena often appear.

IN technology and industry the stro-boscope is rapidly coming into its own Its commonest uses are the observation of rapidly revolving machinery and the measurement of the rate of revolution. Already it is used by many textile companies to regulate spindle speed, on the uniformity of which depends the uniformity of the cloth made from the varn A workman plugs his portable 10-pound stroboscope into the nearest electric outlet, sets the dial at the desired number of revolutions per minute, and walks down the row of spindles. When the flashing light seems to stop a spindle's motion dead, the spindle is functioning properly The speed of spindles turning too fast or too slow is quickly and accurately determined by varying the number of flashes per minute until they, too, seem to stand still In the same way, shuttles and ring travelers are also kept going at the most efficient speed

The automobiles we ride in are freer from "bugs" than they used to be, thanks to the stroboscope. The vibration of crankshafts, the operation of valve springs, the splash of oil in the cylinders — all such operations and many more can be fully understood only when the stroboscope catches their secrets and foibles with its motion freez ing eye. Only by means of the stroboscope and high-speed photography can engineers observe exactly what happens when fuel is injected into the combution that the combution changes of a Direct

Propeller shaft torsion in a famous transatlantic liner, which made its first passengers complain of unbearable vibration, was located, measured, and finally eliminated with the aid of the stroboscope A stroboscopic moving picture of a movie projector showed that one of the two little metal claws which pull the film ahead was not doing its share of the work causing the film to tear Electric razors harvest morning beards more painlessly because factory inspectors adjust the cutters by flashes of stroboscopic light. Electric refrig erators are easier to sell when their moving parts, "frozen" still by a stroboscope, are exhibited in salesrooms High-speed color printing is more accurate because the stroboscope can

method to models of the various strata in a mine shaft. The stroboscope helps to find at what point of stress the roof will begin caving in.

At the Cambridge, Massachusetts, laboratories of the General Radio Company, manufacturers of the stroboscopes most commonly used in industry, is a stroboscopic clock by means of which time intervals can be read to two tenthousandths of a second. This clock. indispensable for radio frequency calibration, consists of two synchronized dials. The left-hand dial, like an ordinary clock face, has a minute hand, an hour hand, and a second hand. The shorter one rotates around the dial once a second, the longer ten times a second. This is too fast for the human eye to observe But the stroboscope easily freezes the motion of the faster hands, making possible a reading of time in seconds. accurate to four decimal places

THE stroboscope was born in 1832. Like so many inventions, it was discovered by two men, Stampfer of Vienna and Plateau of Ghent, quite independcuty of each other. But apparently both men were inspired by some investigation of Michael Faraday's who, in turn, had become interested in the phenomenon of "persistence of vision" through observations made by Peter Mark Roget. British physicist and compler of the famous "Thesaurus" Plateau called his device a "phenaksiotocope, "Stampfer had a less unwieldy name — strobo scope — which stuck Composed of two Greek words, it means, roughly, "whirling watcher"

THE first "whirling watchers," disk-with slots cut into them at regular intervals, were soon used to interrupt a steady beam of light. Professor Edger ton's stroboscope is a logical advance made with the aid of modern electronics a practical, inexpensive instrument to interrupt the light itself at its source As often happens, his development of the stroboscope to its present high point was a by-product of other research Professor Edgerton, in studying the "hunting" and irregular motion of synchronous motors, needed a more reliable and penetrating extension of the feeble human eye than was to be had at that time The work done since, by him and his associates, Messrs Germeshausen and Grier, has startlingly widened the horizon of man's knowledge

Comme soon An article that on suers some puzzling questions as to the serious shortage of diamonds that is hampering Nazidom's war efforts, and the optimistic, but baseless promue of an adequate supply from the Urals in Red Russian The discussion is an absorbing one about "worker" diamonds and their elegant and romanticated cousins—or should we say brothers? Count this as one of the inside was stories we promised, other fine ones are coming—The Editor—



"stop" the presses without moving a lever, and allow the pressuren to see whether the different colors are accurately registered.

Thanks to the stroboscope, engineers are better able to forecast what certain heavy materials and unwieldy structures will do under conditions of strain. At Columbia University's School of Mines, Professor Philip A Bucky (an predict, for example, how much an 83-foot steel beam, weighing 265 tons, will sag under its own weight. An exact scale model of the beam is made, one one hundredth the dimensions of the prototype To produce a pull upon it equal to 100 times that of gravity, the model is spun in a centrifuge, and its deflection is observed by a stroboscope and recorded on photographic film. In this case, it was found that the giant beam would sag one inch Professor Bucky has applied the same

What about wind turbulence and how well designed are the blades of an electric fan' Streamers of smoke blown through the fan give the answers to designers when photographed "still" under the light of a stroboscope

The new, portable stroboscope valuable in many industries, does a regular job of "stopping" motion of the high-speed cutters of an electric shaver so that they may be adjusted. Photograph courtesy General Shaver Division, Remington Rand, Inc.,



W_{inners} in the FOURTH ANNUAL Scientific American



The judges (left to right) Ivan Dmitri, Robert Yarnall Richie, and McClelland Barclay, eliminating photographs in the final judging of our latest contest

Photography Contest

MATEUR photographs by the hun A dreds deluged the editorial offices of Scientific American as the Fourth Annual Photography Contest drew to a close From all over the world they came, forming in the aggregate one of the finest displays of amateur work in this field that we have ever seen When the cream of these pictures had been selected in the semi-finals and hung on exhibition, they were viewed by representatives of the lead ing manufacturers of photographic equipment and accessories Blase though this group might be expected to appear, they expressed the deepest interest, several going on record in the following composite manner "Outstanding among displays of amateur

DIVISION 2

Ist. A. H. Timmons, Glenwood Landing. New York; Zeiss Ikonta, Agfa Superpan Press, Brovira Kashmir Hard.

2nd. Wm. H. Keaton, Wheeling, West Virginia; Voigtlander Brilliant, Eastman Super XX, Defender Velour Black. 3rd. James Liccion, Rochester, New

York; Bantam Special, Eastman Super XX, Kodebrome. 4th. Henry Reid, New York, New York; Leica, Agia Infra-Red, Kodak Royal.

HONORABLE MENTION

Henry M. Blatner, Albany, New York Alvin W. Prasse, St. Louis, Missouri. James Liccion, Rochester, New York. Thomas E. Benner, Urbana, Illinois. Harold B. Stoddard, Wostfield, New Jersey.

DIVISION 1

1st Ludislas Freeworth, Budanest VII Hungary

2nd Alvin W Prasse, St Louis, Missouri, Voigtlander Bergheil, Agfa Super-Plena chrome, Agfa Projection 3rd Thomas E Benner, Urbana, Illmois,

Speed Graphic, Agfa Superpan, Eastman Portrait 4th Elise Voysey, Bayville, L. I., New York, Super Ikonta B, Agia Superpin Velour Black

HONORABLE MENTION

Kenneth Mazawa, Chicago, Illinois Joseph G Danley, Trenton, New Jersey Wm Carlson, Morris, Illinois Ludislas Freeworth, Budapest VII, Hungary, Rev F M Wetherill, S. T D, Philadelphia. Pennsylvania

photography The pictures here are far above the average.

Justly proud were we to feel (and see for ourselves) that there are among readers of Scientific American such a large number of advanced amateur photographers who could turn out fine examples of work Even more proud must be the winners whose names ap pear on this page. They were up against stiff competition and the fact that their pictures survived the gruelling examination of the judges is proof of outstanding excellence

Because of the large number of prize winners, and limited magazine space, we are not reproducing the prize winning pictures this month. We have, however, listed, following their names, the cameras, film, and enlarging papers used by the major prize winners. First and second prizes in each division were solid gold Longines watches listing at \$250 and \$125, respectively. Third and fourth prizes in each group were Federal enlargers. In addition to these prizes, and 15 honorable mention awards each consisting of a one-year subscription to Scientific American, a special prize of \$50 cash was presented to Nathaniel Field, Brooklyn, New York, by the Federal Stamping and Engineering Company, for the best photograph made with a Federal en larger entered in the contest

Watch for announcement of the 1940 Scientific American Contest

DIVISION 3

1st Harry B Forse, Victoria, B. C. Canada, Kine Exacta, Agfa Supreme, Agfa Portrait

2nd Charles W Fairbanks, Rochester, York, Contax II, Agfa Supreme, Kodabrome

3rd Joe Larber, E Lansing, Michigan; Leica, Eastman SS, Pan, P M C 4th Stephen F Harris, Dover, Massa-

chusetts, Auto-Graflex, Eastman SS Pan, P M C

HONORABLE MENTION

Robert S. Holzman, New York, New York. Harry B. Forse, Victoria, B. C., Canada Zia Qadri, Los Angeles, California. Ben B. Hains, Ogden, Utah. Nathaniel Field. Brooklyn, New York,

Algol's Eclipses

ViTH the exception of the Sun, probably no star has been so intensively studied by astronomers as the 'demon' star Algol' 'So begins the latest discussion of the systemujust published by Dr. John S. Hall of

Algol was the first star to be suspected, on the ground of observation, to be really a binary. Before Herschel had observed orbital motion in telescopic double stars. Goodricke, in 1782, discovered that this star lost the greater part of its light at regularly recurring intervals of two days and a little less than 21 hours, and pointed out that this might be due to echipses by an

enormous planet revolving around it Fully a century later, Pickering, having developed instruments for accurate photometric measures, showed that the changes in light agreed precisely, and in detail, with those predicted by the eclipse theory, and so settled the matter pevond question

Since then, several long series of precise observations have been made. The first of these, by Stebbins in 1910, showed half way between the main eclipses a small but definite secondary minimum, due to the eclipse of the com panion by the principal star, and prov ing that this was not a dark planet but a star shining on its own account, though but feebly compared with the other. It was in this work that Dr Stebbinsthen a junior member of the facultywas asked to explain a requisition for "2000 pounds of ice to be used in astronomical observations" His photom eter, now superseded, would work only when the sensitive cell was kept at a uniform low temperature. Eleven years later, with a still more accurate photo-electric photometer Stebbins obtained a light-curve of exemplary accuracy and completeness, and one might have supposed that no more observations were needed, except to keep track of possible changes in the period and the like.

But the photo-electric cells of 1921 were sensitive only to blue and voiced light (of an average wavelength of 4500 A). It is now possible to make rells in which the active surface consists of ceasum oxide, which are highly sensitive to the red and even the infra-red It is with such a cell that Stebhins and his colleagues made the observations of the reddening of the stars by absorption of light in space, of which we spoke last month, and with similar ones that Dr Hall has worked—first at the Sproul

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson
Observatory of the Chromet Institution of Washington

Observatory and later at Amherst. In this way observations were secured with infra-red light, of wavelength 8660 A dute invisible to the eve

The figure, which is here reproduced by courtesy of The Astrophysical Journal shows what a wealth of new information comes from the new observations. The lower curve is Stebbins' for blue violet light, the upper, Rall's for infra-d-differences in magnitude being shown respectively at left and right, plase in fractions of period across the bottom. The dots represent the observations—each one an average of many settings—and define the course of both curves with accuracy.

The principal features—the deep pri mary minimum and the shallow second-ary—are visible in both curves. Both are round-bottomed, with no constant phase, showing that the eclipses are partial. But, with infra-red light the secondary is much deeper and the primary a good deal shallower.

The meaning of this is plain. At the middle of the primary eclipse the fainter star B hides from us a part of the brighter star A; at the other eclipse A hides a part of B, and this eclipsed area is the same, no matter what kind of light we use for our observations. The deeper secondary minimum thus means that B gives out more infra-red light, in proportion to the violet, than the average of the two stars, and the opposite is obviously true for A. Hence the two stars are of different colors. and A must be botter than R. Many similar cases have been known, but the accuracy of the present observations. and the great difference of wavelength. make them noteworthy

The loss of volet light at the principal eclipse is 65 percent, and at the other 3.8 percent The orbit is circular (as is shown by spectroscopic observations). Hence the real distances of the stars from one another are the same at the time of the two eclipses, and the eclipsed areas are the same. It follows that, per aquare mile, star A gives out 17 times as much violet light as star B. In the infrared, the light losses are 50 percent and 11.2 percent, and the ratio of surface brichness is 44%.

From these data, we can find the temperature of one star from that of the other. The spectrum of Algol, that is of star A, is B8—with faint helium

lines. Dr. Hall adopts 15,000 degrees for its "color-temperature" and finds 5900 degrees for star B—slightly hotter than the Sun. The "enormous planet," though undoubtedly enormous, is therefore far from being a dark body but is brighter than the Sun itself

But there is much more to be learned from the light-curves. It is obvious that, between the eclipses, they are not horizontal, but run up toward the secondary eclipse. This phenomenon, discovered independently by Dugan and Stebbins in different stars, is also easy to explain Star A is very bright and hot, its now erful radiation heats up the near side of star B, and makes it brighter than the far side At the time of primary eclipse, or just outside it, we see the side of B which is remoter from Athat is, the darker side, near secondary eclipse, we see the brighter side This "reflection" effect (which ought prop erly to be called heating effect) is decidedly greater in the infra red than in the violet. The whole range in bright ness, due to it-that is, the difference in light between the bright and faint sides of star B-us found to be 6.9 per cent of the total light of the system in the first case, and 3.0 percent in the second These amounts must be sub tracted from the light of the bright side of B (which is the one which un dergoes the secondary eclipse) to find that of the fainter side We do not yet know the former-only that fraction of it which is eclipsed: later calculations show that this fraction is close to 50 percent. The bright side of star B therefore gives out 7.6 percent of the whole amount of violet light, and 224 percent of the infra-red, for the dark side these become 4.6 and 155 percent, that is, 61 percent and 69 percent as much as for the bright side. The dark side is therefore somewhat redder, and must be cooler. Hall calculates a temperture of 5600 degrees instead of 5900 degrees. Only very precise observations could have detected this from an effect nearly drowned out by the powerful light of star A.

A very close inspection of the figure will show that the curves between eclipses bulge up slightly in the middle This effect—which is much more conspicuous in some other systems—arises because the stars are pulled out by each other's tidal attraction and become slightly egg-shaped, with their long ends pointing toward one another. Half way on, and they look brighter. In the present case the stars are rather small compared with the distance between them. and the ellipticity is small, the difference of the long and short diameters being 1.9 percent, according to the violet ob servations, and 2.0 by the infra-red Even this tiny difference makes sense Star B is less massive than star A, and should be more distorted than its com panion. The observed effect is an average between the values for the two stars. taken in proportion to their light Since B is brighter in the red, it should affect the average more. An accuracy even surpassing that of the present admir able observations would be necessary in order to find out in this way just what

the shapes of the separate stars were The question of the actual saze and brightness of each star remains to be settled. With such fine light-curves, this should ordinarily be an easy matter We first "rectify" the curves so as to eliminate the heating-effect and the ellipticity (which is easy) Then—to understand the principles unvolved—we could proceed as follows. Begin by guessing at the light of star B, say 25 percent of the whole in the infrared Then star A gives 75 percent, and at the middle of eclipse 50/75, or 67 per cent of the light of this star is obscured.

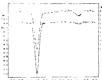
while for star B this fraction is $\frac{17.2}{2}$ or 45 percent. Assuming that the star disks are uniformly bright all over, this eclipsed area is 67 percent of the disk of A, and 45 percent of that of B. Hence the fainter star B must be the larger, and have 1 22 times the radius of the

11 2

F we know the relative size of the stars, and the maximum percentage of eclipse, an easy calculation (with the aid of tables prepared for the pur pose) gives the form of the whole light curve, if we are given the width at the point where half the maximum amount of light is lost. This can be read from the observed curve. If the calculations are repeated, with different values of the assumed brightness of B, we will get different calculated curves All will agree with observation at the half way point, and at the bottom, because they were made to do so; but some will be narrower in the lower portion and wider at the top, than others, Comparison with the observations shows what value of the light of B fits the facts. The actual process of calculation is less clumsy than this but based on the same principles.

It ordinarily leads to quite definite results; but in just this one case of Algol there is an unusual complication Spectroscopic observations show, as was to be expected, that star A is moving in a circular orbit about the center of gravity of itself and B But long-continued observations have proved that this close pair is itself a part of a wider one, with a period of 670 days—revolving in a slightly elliptical orbit about the center of gravity of itself and a distant companion C.

Neither star B nor star C is bright enough for its spectrum to escape being drowned out by that of A in the violet region where radial-velocity observations have been made—even when this star is partially eclipsed But this means



Light curves of Algol's components

only that C does not give more than 10 or 12 percent of the total violet light of the three together—and possibly more of the red light.

We have now a new uncertainty in our calculations Assuming, for example, that 6 gives 10 percent of the total infrared light, and B 25 percent, as above we have 65 percent left over for that of A, and, proceeding as before, find that 77 percent of the area of A 18 eclipsed and that B has 131 times the radius of 4. By the same method as before, we can find a new value for the brightness of B which will give a good fit to the observed light-curve It turns out that whatever guess we make about star C, we will get practically the same calculated best-fitting light-curve, and will have no way of telling which of our guesses is the best

We have still one recourse, of a different kind, depending on the masses of the stars. We cannot calculate the masses from the spectroscopic data unless we know how far stars B and C are on the other sides of the centers of gravity of their respective orbits; but, at least, we know a relation between the masses—which with due apolozy to our readers, it appears cassest to express by means of algebra. If A, B. C now represent the masses of three stars (with the Sun's as unit) the data for the close pair give

$$B^{\bullet} = 0.026 (A + B)^{\bullet}$$

and for the other

 $C' = 0.059 (A + B + C)^2$ (Here it is assumed that the orbit of the wide pair, like that of the close pair, is nearly edgewise to the line of sight)

If we can find the ratio B/A in any way, the first equation gives their values, and the other then gives C.

Now there is, on the average, a close relation between the mass and luminousity of the stars, and, from the ratio of brightness of any two, we can estimate the ratio of their masses. On this basis. A should be about twice as massive as B Setting A = 2B, we find at once A = 0.47, B = 0.23, C = 0.42. This will not do, for several reasons, First the actual brightness of Algol (star A) is about four times that of Sirius, and we should expect it to be more massive than Sirius, that is of at least three times the Sun's mass. Secondly, if C is almost as massive as A. it should be about as bright-which ii certainly is not

 \mathbf{H} ALL adopts A=1.6, which makes B=0.48, C=0.79. Star C should then give one sixth as much light as star A, and the spectroscopic observations are explainable But the brightness of star B, calculated from its mass, comes out only a quarter of the observed value. There is something queer about one of these three stars. The assumption that star B is too bright for its mass appears to be the most reasonable one to make, for we know that such things actually happen.

The bright star, Zeta Herculis, for which we have accurate data, has very nearly the Sun's mass—or slightly less—and almost exactly the same spectrum and color as the Sun We should expect it to be a little fainter than the Sun, but it is four times as bright, and must have about twice the Sun's diameter.

Stars of this sort appear to be moderately uncommon But the best place to look for them is among the large faint companions of eclipsing variables. Struss, for example, is probably 1.8. Struss, for example, is probably 1.8 that a close companion just like the Sun, an eclipse by this would at best be annular, and cut off about 35 percent of the light. But a companion of the same mass and secting the structure of the complex of the same mass and exchange it totally, and cut off 85 percent of the combined light, producing a conspicuous eclipse when the other would stand a poor chance of being discovering the constitution of the combined contained to the grade of the combined stand a poor chance of being discovering the constitution of the combined that of the combined start and the combined that the constitution of the co

When we hunt for eclipsing variables we are making a special search for large companions of low density, whether we realize it or not. So it is not remarkable that we find them.

If only the spectrum of other star B or star C could be observed during the principal minimum, a great deal more could be found out about Algol Spectroscopic observations in the red might help—and would be worth a good deal of trouble to make.—Princeton, December 5, 1939.



Double-check by engineers who are laying the groundwork for new maps for motorists by driving over the area with government topographical maps

Seven Million Maps

By ANDREW R. BOONE

TSING United States Government topographical maps as a base, engineers for the Automobile Club of Southern California chart streets and roads by actually driving over the territory. Driving thousands of miles monthly, they keep up to date 1000 maps and help make available 7,500,000 maps each year to motorists. As they drive, they also consult California highway, county engineer's, and United States Forest Service maps. In the laboratory, scale of the base map is changed by a pantograph to conform to size of map

> After all available data are collected, the completely corrected map is put under a pantograph and redrawn to a new scale that will be

> in keeping with the mo-

Proofs of type-set wording are trimmed to size and pasted in place on a largescale black-line print that

desired. The original layout is first made on tracing paper by pencil, and from the layout an ink tracing is sketched Following completion of the tracing, a photographic negative is made, and a positive black-line picture printed The black-line is then mounted on pressed wood After printed letter ing is pasted at the appropriate posi tions, the map is photographed and reduced in the form of a wet-plate negative to printing size A color separation is made on this negative from which various lithograph color plates are produced, at the same time another print is made from the wet plate on sensitized zinc, on which mountain relief is sketched with wax crayon. These plates are now made ready for printing the completed color map.



Preparing wet-plate negative from which lithograph plates are made





Tire molds, made by usual engraving process, require over 165 man-hours to produce



Sections of electro-formed tire molds before and after being backed with cast aluminum Such molds are harder than older types and are excellent conductors of heat

Molds By Electro-Forming

PESEARCH, desuned to find a proccess for the chraper production of the velopment of a method of producing a variety of elaborate articles hitherto probibited bit tool costs. The new procces, known as Ekko, comes from the laboratories of the United States Rub ber Company, and has now been made available to industry at large.

The Ekko process produces molds and dees by electro-forming ron against a pattern it is desired to reproduce Electro-forming is the same as electroplating except that deposits up to ½ of an inch thick are produced instead of the 1 1000 to 2 21000 of an inch thickness of metal applied by the usual electro-plating processes Electro-plating is used for decorative purposes or to provide corrosion resistance, while electro-forming is used to build up a mass of metal.

THE electro-formed mold, with which is to be made tires or other products can be made at a considerable saving over the cost of an engraved mold It requires considerably less labor and, in the particular case of tire molds, fin ished forms can be mounted in what are known as "watch cases" already available from old molds A further advantage is that the iron deposited by the electro-forming process is 99 98 per cent pure and is substantially free from porosity. It is about 50 percent harder than cold-rolled steel but can be softened to the normal value of pure iron by annealing or so hardened by carburizing that it will scratch glass. It has a heat conductivity nearly twice that of cast iron or steel-a valuable property for heat molding where a high rate of heat transfer is desirable.

In making an electro-formed mold of

a tire, a pattern or matrix is first abtained from an engraved mold. An adjustment is made to provide extra metal, where the new mold must later be cut in two. Then the pattern is made an electric conductor by dusting it with powdered graphite and polishing it vigorously with a light brain. Following this, it is placed in the electrolytic bath and electro-plated. The easemtal difference between this and ordinary electro-plat ing as indicated above, is the much greater length of time the plating is continued.

Many types of materials such as wood glass, plastics, and so on, not attacked by the plating bath, may be used for



The embossing trade can also use the new process for making such molding plates as that shown at left above It was made on the imitation leather pictured above at right

The electro-formed mold for a hand, described in text, as shown in two parts in picture at right. The finished hand slips on the stump of the girl's wrist making the pattern upon which the mold is to be deposited

One of the first applications of the electro forming process to other than tire molds was the preparation of a sponge rubber hand for a young girl who had been in an automobile accident This was made at the suggestion of a sculptor friend of the young girl because of a feeling that the usual type of artificial arm would be highly unsatisfactory with long sleeves as well as with short ones. The sculptor are pared a model of the missing hand in plaster of Paris, correct in every detail. This reproduction was used as a pattern to electro-form an iron mold, which was then used to mold a reproduction of the hand in anonge rubber. This artificial hand provided lightness and resiliency. was tinted to match skin coloration and required no straps or braces but permitted the wearer to open doors and drive a car.

Since the successful preparation of the mold for the sponge rubber hand, which indicated the desirability of electro-forming in the rubber industry, the Ekko process has been successfully applied in the plastics, glass, embossing, and metal stamping industries.



Engineering In Dentistry

HAT! Engineering in den tistry? Absurd!" So might most of us speak

But there is engineering in dentistry today along with metallurgy, ceramics, and art. It is quite probable that the dentistry of tomorrow will require the same combination, although many hope measures. Some of the best minds in the profession are concentrated on efforts to attain this much desired end, yet there are mysteries that are just as imponder-able today as they were hundreds of years also.

Despite the fact that dentistry can be traced back to long before the Christian era, the present technical and scientific advances have been very recent. A hundred years ago dentistry was not very much different from that practiced by

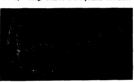
the Etruscans over 2500 years before. The oldest denture in existence was found in the jaw bone of an Etruscan who lived before the Sixth Century 8 L. It consisted of four loose teeth secured by a ribbon of gold to the firm teeth on each side of the cavity. Often the teeth in these crude dentures were not human teeth but were carved from the tusks of animals

For the most part, early Nineteenth Century restorations were similar contraptions of loose human teeth, wire, and springs. Solid plates were being carved from wory but were little, if any, better and were much more expensive. An ivory set belonging to George Washington is now in a museum Some work was then now in a museum Some work was then being done in Europe with porcelain teeth set in gold bases, but centuries old processes and designs were most common

Much of the transformation from these clumsy devices to the durable, comfortable, and good looking dentures of today is due to the application of engineering to dentistry. As the engineer builds a great river bridge, so does the dentist of today make a restoration for the human mouth He follows the two engineering steps of design and selection of materials, aiming to secure the greatest all around efficiency from the most suitable materials Poor design and inferior materials mean failure for both engineer and dentist Instead of fastenmg loose teeth in the mouth as of old. the dentist plans a denture that will be strong, long wearing, comfortable, and compatible with the wearer's natural Dentists' Main Problems are to Get Strength Plus Resiliency... Add to This: Art... Precious Metal Alloys and New Porcelains Meet Needs of Dentists

By A. W. JESSUP

appearance All of these are important. The first step for bridge and denture building is design. For the dentist, the design problems are complex and exacting. He is under greater restrictions as to the size, shape, and weight of his structure than is the engineer. Each restoration, furthermore, is an entirely new job. for no two human jaws are exactly alike. The denture must be strong, for the forces exerted by the jaw, in masticating, range from 25 to 275 pounds with differ-



Ancient and modern dentures. Above is a crude Etruscan affair of gold and carved animal tusks, dating from 500 B. C (Courtesy the book "Geschichte der Zahnheilkunde") At the right and below are views of an elaborate modern denture, with a model of the mouth it is to fit. The latest alloys and porcelain teeth were used to make this one

people who are continually in the public eye but also for those in ordinary walks of life as well. Hence our dentists have so perfected their processes that most dentures improve the wearer's looks. Also contributing to inconspicuousness are smaller artificial teeth, and precouss metal alloys and porcelains which match the natural coloring of mouth tissues and cannel Dental science has advanced so far that the fulfillment of the eathert desire does not necessitate the sacrifice of the other desirable qualities in a restoration.

All of the dentur's labor on design would be useless if he selected interior materials for his dentures. Dentutes of the past have used wood, wire, tacks, and both human and animal teeth for resortations. Today, they turn to the many precious metal allows and to porcelain Various combinations of platinum, palladium, and gold meet the many present day needs. The premier requirement of

a dental metal is an abulty to undergo the stresses of masteation without permanent bending or loss of shape. To the patient, this retention of form while in use means a long-lived, comfortable restoration. The clearest examples of this property are the clasps by which partial dentures are secured to the natural teeth. These metal clasps are spring over the contours of the teeth and, if made of an inferior alloy.

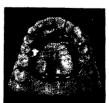


inforce those points that have to bear the greatest load and shift some of the pressure to less taxed parts

The patient's comfort and physical an-

The patient's comfort and physical appearance depend on proper designing of the denture to fit the oral cavity perfectly it is easy to see how a too-large or badly shaped restoration would be painful and would detract from a person's natural appearance.

In recent years, the demand for appearance has become almost as important a requirement as comfort and serviceability. This is true not only of



would soon be spread and bent out of shape by the pressure of insertion and removal. Frequent read justment and much discomfort and inconvenience would be the price paid by the patient

What about the natural teeth still in the 1aw? Nothing must be done to harm them and cause their early loss The dentist, therefore, at every turn selects materials that will not injure them The alloys must be hard enough to wear well. but must not be so hard that they will abrade the adjacent and opposing teeth Wear and mury would be rapid if materials harder than the natural enamel were used. Since dentures must shooth the stresses of mastication, resiliency, as opposed to rigidity, aids in preserving the natural teeth

As temperature has a marked effect on the sensation of tasting, conductivity in full dentures has to be com natible with that of the natural teeth and mouth tissues, otherwise the patient's dietary habits would be violently disrupted Ability to discern temperature of food and drink at near the natural rate has the added advan tage of helping prevent serious mouth burns

While the dentist was perfecting his dentures, he was demanding better and better materials from the metallurgists and ce-

ramicists. As a result of their mutual cooperation, the producers of precious metals created alloys to meet the in creasingly rigid requirements Further aid came from the Bureau of Standards which began research in 1919 that resulted in numerous specifications for dental metals. Thus the dentist can obtain alloys which accurately fulfill his various requirements

METALS have been used in dentistry as far back as there is record Until the middle 1800's, gold retained its place as the premier dental metal To procure a harder and stronger metal. small amounts of silver and copper were alloyed with gold Later additions of platinum and palladium were found to give even more desirable physical properties. Experimenters, combining plati num with gold in 1875, found a 12 per cent platinum alloy had exceptional strength properties. In more recent de cades dental metallurgists investigated palladium for dentistry. It does not have the same weight and cost-limitations as platinum, and may be used in much larger quantities as an alloving element with mold

In the natural course of searching for the ultimate alloys, dentistry will probably never stray very far afield from the use of the precious metals: platinum, palladium, and gold. Combinations of these meet all of the dentist's requirements for strength. Moreover,



Dentures are made by what is essentially the lost-way process of casting. In the first step, above, the denture is formed and sprued (provided with a gate to receive the molten metal) in wax on the model that was made in place



ter from a plaster cast of the patient's mouth. Then, right, above, the wax pattern i removed from the model and painted with investment, a dense, plaster-like material







The wax pattern with painting completed, above, left, is placed, point down, in the casting flack above, center. The top of the flack ready for casting is shown at right, above. This is placed in a centrifugal custing muchine, the platinum-palla-



in a cup before the sprued mold, and the machine is whirled to throw metal into all parts of the mold h lows left by melted wax. At left is the rough casting and at right is the completed denture after trimming away the sprue metal and any minute roughness, and then polishing the piece



all of the precious metal alloys have a hardness compatible with the natural enamel, and a suitable resiliency.

The new alloys and porcelains make possible smaller toeth that previously were not strong enough to be practical Porcelain has been developed on a mass production basis and, from stock molds. more than 90 percent of the natural teeth can be matched perfectly for size and shape

Besides being an engineer, the den tist is also an artist. The recent esthetic demands have caused this Cutting down the size of artificial teeth was a big stride toward the fulfillment of this desire. Teeth, furthermore, are made in shapes to match the three facial forms-square, tapering, and oval. Also contributing to denture appearance is color. Precious metal alloys are available in all shades from platinum-white to yellow for inlays, crowns, dentures, clasps, and wire. Nearly all shades reflect the natural color of the mouth and are therefore less noticeable. Porcelains are also colored to match the natural

enamel Not only have rapid strides been made in the scientific aspects of dentistry, but also in the training of the practitioners themselves Webster's first American dictionary published in 1828 defined the dentist as "one whose occupation is to clean and extract teeth and repair the loss of them " What it failed to reveal was that he was also occupied with the business of cutting hair and shoeing horses Today they must undergo at least six years of intensive university training-two years pre-dental and four years in one of the more than 50 accredited dental colleges in this country.

Dentistry is no longer a hit-or-miss business. When we have need for dental work, we can sit with confidence in the dentist's chair-confidence because we know that he knows what he is doing, that he has the best materials and that he won't spoil our good looks. This is a far cry from the operations of harbers and blacksmiths of a century ago.

Spare Parts

By G. H. ESTABROOKS

W E are all familiar with certain bosses which the human can save tain and still live. An arm, a legeven both arms and both legs may be even both arms and both legs may be fourse, the loss of an ear is a meet trifle if your teeth don't suit younged acer, while city and produced and the extremely all the produced and the produced and the produced are only encumbrances, while our old frend the appendix is a new version of the white reands burden

All these possible alterations we more riess take for granted, but when the surgeon opens up the body and start-tinkering with our "innards." then we feel he is treading on very dangerous ground And he is Yet, for all that, large portions of our internal nantomy can be removed, altered, or replaced and we are still a gong concern

Man is like your auto-his engine will keep running after you have removed a whole carload of mud guards, hoods, body parts, even tires. To be sure, it may be a sorry looking wreck with which you end, but the essential life-producing engine, both in auto and in man, will still be turning over even after the wrecker had done a pretty thorough 10b Interfere with any vital part of the en gine, however, and no matter how beautiful your car-or your human-it is dead on the instant Modern surgery gives us some fascinating glances at the human engine, revealing to us many "spare parts," once considered essential but without which the human can now function very nicely

IT is, of course, absolutely necessary that we have a supply of arr. Without the oxygen contained in the air, the human engine simply cannot run. Nature, foreseeing trouble in this area, has given us considerably more lung capacity than we really need. We can get along very inceyly on one lung or even half a lung, provided we don't go in for

Man has learned some interesting tricks in handling lung diseases. Tuber culous, for example, is a very dangerous disease, best treated by going the involved part complete rest. Then your body handles the bug at its lessure. But how can you put a lung out of action? There are several ways. One is to literally pump you up. Immediately outside the lung is the pleural sac, made up of two very smooth surfaces which also over each other every time you breathe. Sometimes these surfaces become urri-

tated and you have pleurisy, which can be very painful So, when the tubercu losis apecualist wishes to give one of your tangs a holiath, he punctures this pleu ral sac with a large needle and pumps it full of introgen, using this gas because of its mert nature. This compresses the lung so that it cannot work. The nitrogen will be absorbed only slowly by the tussue, but it as absorbed, for all that, hence every two or three weeks you have to report back and get inflated. N_0 —you, con't meet a permanent heyele valve and more yourself on work free valve and more yourself on work free valve and more yourself on work free.

Another way in which this lung can be given a rest is to cut the nerve which supplies it. Then the lung is literally paralyzed, and if the situation is handled properly this nerve will grow back again and the lung will be restored to activity at the end of, say, six months Still another, and much more dangerous way of handling the situation, is the tech name of removing an entire lobe of the lung This is a major surgical operation in which the doctor has to cut through the ribs, the chest wall, and disconnect part of the lung itself When you realize how great is the blood supply to these parts it is a wonder that death from hemorrhage is not the invariable result However, this operation is used only as a last resort and modern surgery is making immense strides in controling just such attuations

One of the most curious of all methods in modern medicine is one in which they literally cut your throat in order to make you more comfortable. It sometimes happens that certain nerves supplying the larvax or "voice box" become para lyzed, resulting in a disagreeable situa tion wherein breathing is very difficult The intake of every breath requires a gasp but, strange to say, you can breathe out or talk with perfect ease, once you get the air into the lungs. So the surgeon nonchalantly cuts your throat He bores a neat little hole into the windpipe below the larvnx and you breathe in through this The air also passes out by way of this route-unless you want to talk, then you hold a handkerchief over the hole, thus forcing the air through the vocal cords, and you talk as well as ever Cenerally this hole is concealed by a neck band or other covering You could actually talk to a person who had had such an operation without noticing the injury or suspecting why he kept his handkerchief pressed to his throat.

At times the surgeon finds it necessary

to remove the entire laryax. Cancer may render it useless and the disease might also spread to other nearby structures, so he cuts it out and installs one made by Western Electric. Not quite as good as the original, to be sure, but it makes speech possible and you certainly could never contract laryingtis in that contrap

The so called "artificial lung" is not a space part. It is just an ingenious machine for supplying artificial respira tion-for forcing you to breathe when the lungs become paralyzed, as in in fantile paralysis. Given time nature may -or may not-be able to repair the paralysis resulting from this disease By "time" nature means from three to six months, a long period to go without breathing The artificial lung manipulates the pressure on your chest so that air is forced into and out of the lungs If these recover from the rayages of in fantile paralysis, you can be taken out of the "lung", if not, it is only a matter of time before death ensues Many people have literally been snatched back from the grave with this spectacular

M ODERN medicine can do a great deal with the breathing apparatus. but nature flashes a bright red warning light when we approach the heart. The individual's life is in danger when we even touch this complicated and beau tifully coordinated blood pump, while only the most skilful surgeon dares operate Even so, his invasions are confined to the surface of the organ In stant death would be the result of any such liberties as he might safely prac tice with the lungs To be sure, we may tie off an artery or even remove a vein, and so modify circulation, but the heart we must respect Even this matter of tying off an artery is not so simple If, in an automobile accident, you cut the great artery leading down your leg or arm, the surgeon will probably amputate irrespective of bone con You have cut off the blood supply, which may easily lead to gan grene, and just about anything is prefer able to this form of tissue clot.

Of course, in one sense of the word, your blood is really a spare part. To be sure, you cannot live without it, but the doctor can remove a couple of quarts of blood without doing you any particular harm. This he can then inject into the veins of a very sick patient, who for

The Human Body Contains a Remarkably Large Number of Parts Without Which it Can Survive or Even Function Normally . . . Some are Duplicates

one of many reasons may need blood, and so save his life. He has to be very careful that you are in the same blood group as the recipient and, needless to say, must exercise every precaution that you are not suffering from any disease, such as malaria or tuberculosis, which can easily be passed on by blood transfusion But there are less obvious dan gers I just noticed that a case of hav fever has been thus transmitted Prob ably all these allergic conditions act thus, while immunities, even susceptibilities to certain other diseases, may be passed along by way of the blood route Of more interest is the trick of inserting glucose directly into the veins Sugar is the fuel on which our engine runs and this insertion of it is of tremendous importance in certain cases where the patient has not the time or the ability to take in the food by the stomach

The endocrine glands are now al most being relegated to this spare part rôle. We cannot do without them but we can prepare their secretions outside the human body and inject them should the gland become diseased Diabetes was once practically a death sentence It is caused by the absence of insulin secreted by cells in the pancreas We now manufacture this substance from animal glands and the diabetic can be healthy and happy with his hypodermic needle. if he just won't overdose or underdose If he does, then insulin shock or diabetic coma offer a quick and painless road to eternity The deadly Addison's dis ease, caused by a deficiency in the cortex of the adrenal gland, we now control by the recently discovered "cortin" The thyroid gland can cause any condition from idiocy - the cretin - up to a maniac state of insanity-which often accompanies exo-pthalamic goiter. The cretin we can at least help by injecting thyroxin and in the maniac state caused by too much thyroxin, we remove a large part of the gland.

In certain rare cases man loses the four little parathyroids in the neck. This was almost invariably fatal until a Canadian discovered an injection which keeps the patient alive. These little glands are literally apare parts. If the individual can live six weeks after their removal, the body will compensate for the loss and he is healthy without either the glands or their secretion. Several of the glands, however, still hold their secrets. We cannot prepare the secretions from the pineal, thymus, or pituitary. One obvious solution to this gland problem would appear to be

that of grafting, but grafts have been quite unsuccessful except in certain cases associated with the sex glands and these are questionable

Plastic surgery of one kind or another gives us startling examples of interchangeability in body parts. These days of automobiles yield some bad face wounds and here the plastic surgeon does his most spectacular work. A new nose bridge, jaw, or other facial part needs only live bone tissue and proper modeling for a graft --- and any of us can spare a rib So the surgeon con verts part of a rib into a nose bridge borrows a few square inches of skin from your chest to make an upper lip or a cheek does a very neat job of sewing things up, and you'll pass at tea in any drawing room Grafts of skin, bone, and muscle are also possible in other parts of the body, ravaged by disease or accident

FROM the biologists' laboratories we are getting some very fascinating hints as to possible developments along these lines. The biologists have found for example that they can graft eyes in the case of the salamander. The new eye grows into place and apparently functions quite as well as the old With insects they can even take developing eve tissue, shift it to a totally different part of the body and get an eye on abdomen or tail One enterprising biologist has trans ferred heads in insects, even to different species! Needless to say, such experi ments have no practical value whatso ever to the human - but give us time In all great centers of research humanity is literally following Aristotle's great dogma "The highest study of man is

Some of the surgeon's most spec tacular work in this spare part field ifound in operations on the food tract We regard the stomach, for example as essential to human life. But you can get on very nicely without a stomach You may have to watch your diet a little more carefully or eat at different intervals than you do at present, but when your stomach becomes cancerous or the walls become weakened with gas tric ulcer, the surgeon may take the whole thing out and call it a day. The food then enters the small intestine direct, without this stomach stop-over The main task of this organ was to break down proteins, a job which is also done in the intestines, so it merely means that certain intestinal juices have to work overtime.

Similarly, we find that you can lose a

yard or two of small intestine with no particular discomfort. The whole of this 30 foot organ is used for digestion, that is, to break down food substances into very simple combinations which can then be absorbed through the intestine time walls, thus entering the body proper. The small intestine is really more in portant to digestion than is the stomach, but there is a lot of it. So a few odd vards don't really count too heavily.

And the same applies to the large miesture, the colon Here, waste from the food is stored prior to being ejected from the body A certain amount of absorption takes place, but the colon is also a potential seat of infection It is an also a potential seat of infection It is an also a potential seat of infection It is an easy matter for this food waste to start decaying and this may quickly infect the intestinal wall, especially if its free passage from the body happens to be blocked So, when this condition occurs when the surgeon may remove the entire colon having the food leave the body directly from the small intestine

We seem to get on very nicely with out the gall bladder or the splien, two organs whose functions are still more or less of a mystery. Nature draws a line however, at the liver. This organ is the body's gasoline tank. Here the muscle fuel — sugar — is stored prior to use and nature will not allow any tinkering with the fuel supply.

Kidney function is of vital importance to bodily health. The kidneys are responsible for removing waste products of a great food group, the proteins Interference with this function to any degrees is dangerous. Its stoppage results in death the body simply clogs with its own refuse and the machinery stops But nature seemed to realize that infection or injury here might be very probable, for the kidneys, from the nature of their work as refuse removers can easily become infected. So we have two kidneys, always in running order and always functioning, but we can get along very nicely with only one When necessary the surgeon can operate and remove an infected area of a kidney or a whole kidney, if necessary

Similarly, the bladder may become moved. This condition is not as common as is kidney trouble, for the blad der is a very simple organ, in striking contrast to the very complicated structure of the kidney. Nevertheless, disease may occur here and, when necessary, the doctor adopts heroir methods and removes the entire organ, with no serious danger to the patient's health but considerable inconvenience as to habits of cleanliness for his remaining

Nature exercised the greatest foresight in the care of the brain, the control station for the human engine. Not only did she enclose the brains in a case of armor—the skull—but she literally gave us two sets, just in case one got put out of action in the battle of life. Generally speaking, the human body is controlled from the left hemisphere of the brain In left-handed people this localization of control is reversed, but the general principles remain the same. So unum portant, indeed, is this unused side of the brain that it would be quite possible for a skilful surgeon to remove the entire right hemisphere in a right-handed indi vidual without causing any serious ef fects. Death, in the case of head miury is because of blood pressing on certain structures at the brain base which control the action of heart and lungs. The miury can be extensive but if no pres sure is put on these parts the individual will not die Indeed, the odds are all in favor of his recovery, especially if he is

One wary curious fact about the brain is the very clear-cut localization of cer tain functions For instance, if you are a right-handed individual, you hear with the left side of your brain, just in from the temple. You see, currously enough. in the extreme back of your head, left side This is where the nerve from your eves ends You feel a burnt finger near the top of your head, just forward of the center line You talk with the extreme front of your brain, just over the eyes, and you play the piano, another motor activity, a little above your speech area, both left side. If you are left-handed. reverse the sides and you have it. If ambidextrous, heaven only knows what you do, but you probably favor the left

A FRENCH-Canadian friend of mine was hit in the head by a shell fragment. The left side of the skull above the ear was so fractured that a large silver plate was installed in its place. The brain was, of course, badly injured The shock rendered him unconscious for a couple of weeks On recovery he presented a fine example of auditory aphasia, that is, loss of memory for all sounds couldn't speak and he couldn't understand what you said, for the auditory memories were all wiped out. But the right side of his brain was unhurt, so nature switched over to this "spare He learned very rapidly to part " speak, although he never did get back his native tongue, French A brilliant philosopher before his wound, his later views on Aristotle would have disgraced a college freshman, but he relearned his military manual in short order, returned to the front in a year's time, and ended as a colonel of infantry!

Nature will make interesting use of these spare parts in the brain when forced so to do. For instance, we take a rat and teach him a visual discrimination test, such as to distinguish between a square and a triangle you feed him on the square but when he trespassees on the triangle he gets his paws shocked. So he learns very quickly Like all mammals, humans in.

cluded, he sees with the back of his brain, and there are stored his vasual memoraes. Now we operate on this acction of his antony, removaing the brain tosaie next the vasual nerve's end On recovery he has completely lorgotten his track, but he will learn it or a similar one again and just as quickly, using brain tissue farther removed from the nerve ending. In other words, these large, so called "blind areas" of the brain are samply masses of reserve brain cells, of spare parts, waiting to function if and when necessarily

Some of the problems presented by these curious shifts in control are still very obscure. For example, the so-called primary motor area is situated roughly above your ears. When you have a 'stroke" it is generally caused by a blood vessel bursting in this area and paralyzing the motor nerves which con trol arm, leg, or what not Such a mishau is very serious in those of advanced years Now, suppose we operate on a dog and carefully remove the motor area that supplies his hind legs. On recovery he is of course, paralyzed Then a very curi ous thing happens. At the end of a month, he begins to regain the use of his legs. In two months he is as good as new And, to be quite frank, no one knows where the control has gone Nervous tissue never grows back, and in this case the neighboring tissue does not take over the management. Our best research men have written reams on the subject, but that particular spare part is still missing. It's like having an extra timer in your car, of whose presence you are certain but which is so cleverly concealed that the best mechanic in the country cannot locate it

The medical eve of the future will be even more concentrated on this problem of spare parts. Three groups of dis eases are steadily increasing in fre quency These are diseases of the heart or circulatory system, of the lungs or respiratory system, and finally our old enemy, cancer. The reason for this increase is obvious Your life expectancy has jumped from about 20 years to over 50 years in the past cen tury We won't let you die of tuberculosis, typhoid fever or smallpox, but you've got to die of something sometime The machine just wears out, like any other engine and the two pumps, air and blood, generally go first. Perhaps some day we may literally have an artificial heart or lung

Cancel 1s the very worst example of anneplaced spare part. It is simply ordinary body tissue gone wild. Some cells in your skin, stomach, bone, or brain decide they are going to grow and do so, invading other organs and crowding everything out of place. Here are spare parts which could easily be spared with loss to noe. The dickens of it is that there is no germ to jump on—just that there is no germ to jump on—just that they do not many body tissue and arwthing to grow the second and they tissue and arwthing the second or the se

which kills this cancerous tissue will probably kill the other body parts at the same time. This is about as neat a stalemate as anyone could name; yet even here there is hope, for this cancerous tissue has certain peculiarities which may some day prove its undoing.

But we must have patterner. Medicine with its allies in other sciences with continue to master the secrets of man, the machine. All it demands from the layman is an enlightened ignorance—inother words, co-operation, but not interference. Here, as nowhere else, a little knowledge may be a very dangerous thing

NTERESTINC. also, are certain "spare parts" which man has added of his own accord It seems fairly certain that he evolved in a sub-tropical or tropical climate. Here he could survive very nicely without a coat of fur, also, as a forest animal, he needs't worry about too much sun But ambition has always been his downfall First, he decided to leave his forest, then to go north That meant clothes, for his naked skin was poor protection against blizzard or the burning heat of the tropical veld:

These spare parts became just as nec essary as many we have mentioned If you were a savage or even an early colonist in, say, northern New York State. and had your choice of living without your clothes or losing an eye, you would make the best of a bad bargain and part with the eye. Therefore, to early man came more demands for spare parts Furs and a fire can support life even in Canada, but if man is to have any peace of mind some form of house is absolutely necessary Hence this tropical animal endowed with intelligence moved his southern climate north in the form of an artificially heated home. When winter comes, he hibernates with brief excursions into the outside world for farm chores, a dash to the office, or a ski trip. Yet, take away his clothes, rob him of his fire and the wolves could have all Amer ica north of Mexico, with some of the Mexican highlands thrown in!

The trend of evolution seems fairly clear. Man will add more of these external spare parts and lose some of those in his own hook. Your glasses are becoming more and more essential Even the auto and the radio have almost become essential to human existence, not to mention many older inventions. On the other hand, man's teth are going. They already are babylike compared with those of the lava man, the Pildown man or the Heidelberg man, his pre-cursors of a mere few hundred thousand years back His little toe is also on the way out.

However, a good many of us suspect that man himself will fool Mother Nature and prevent further evolution simply by himself becoming extinct within the next 100,000 years.



DIGEST MONTHI.

Conducted by F. D. McHUGH

NEON LAMPS SIMPLIFY SLIP-SPEED CHECKS

IN addition to the more involved and more expensive atroboscope equipment with which the test department of The Reliance Electric and Engineering Company is supplied for obtaining speed values of alter nating-current machinery, its engineers have devised a simple, portable unit, using neon lamps, which is ingenious and as easy to use in the field as in the shop

Four, clear bulb, three-watt, neon glow lamps in a group, arranged as shown in the accompanying illustration, are used. This is



A simple hand-held neon lamp unit accurately checks A.C. motor speed

cessary because the lamps are made for 115-volt circuits and to use them directly in the motor circuit, as must be done in testing, requires that provision be made for operation on 220 volts and on 440 volts

Four standard lamp bases are mounted on a small board A consent hood of steel, painted black inside, serves to keep out other light rays On the back of this board is mounted a switch for connecting the lamps for either 220 or 440 volts

The neon lamp can be used for obtaining the slip-speed of any alternating current motor with the exception of high-slip motors, operating at more than 100 revolutions per minute slip The device is easy to use by directing the light on the end of the shaft and counting the number of revolutions per minute of the keyway or other fixed parts on the rotating element. Marking the end of the shaft with a single chalk mark simple

Contributing Editor ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

fies the counting, and using a stop watch increases the accuracy of observance of the time interval used Subtracting the slip revolutions per minute from the synchronous speed gives the motor speed

Of course, in a plant where all alternating current comes from the same source of con trolled frequency, only a single neon lamp is needed

WEIGHTING "TOP-

HEAVY" DESTROYERS

OPHEAVINESS in 12 American de stroyers, subject of much recent dis cussion, can be corrected by adding 40 or 50 tons of lead to the keel of each ship, rearranging stores, and removing some of the deck furnishings. Navy engineers state Total cost for work on the entire group of 12 destroyers is estimated at between \$600,000 and \$1,000,000

Weighting the keels may reduce speed by about half a knot This, however, is not regarded as serious, since the ships, designed for 37-knot speed, actually made 39 on trials

The destroyers of this group are among the most formidable armed craft of their class in the world. On a designed displacement of 1570 tons, they carry 12 21-inch torpedo tubes, five 5 inch guns, and a number of lighter anti-aircraft pieces. The 5inch guns in all recently built American destroyers can also be trained for highangle fire against aircraft -Science Service.

KOROSEAL PAINT FOR CORROSIVE CONDITIONS

GAIN extending the use of its recently AGAIN extending the decoration Koroseal, The B. F. Goodrich Company announces a new Koroseal paint, designated as No 495 Korolac A Korolac primer for use with the new paint is also available.

The new paint gives a semi-gloss black tremely corrosive conditions disqualify any other kind of paint or coating Applied to metal surfaces after they are prepared as for any other kind of paint or lacquer, the primer forms a strong bond between the Korolac and the metal itself

Korolac No 495, when thoroughly dry, will withstand all acids, alkalies, and salts in the concentrations commonly met with in industry, up to temperatures of 150 degrees, Fahrenheit It is not affected by chrome, nickel, cadmium, zinc, copper, brass, silver, or tin plating solutions, nor are such solutions contaminated or fouled by the paint when it is thoroughly dry.

Ordinary atmospheric conditions have no effect on the paint. It is extremely moisture resistant. The dried film is hard and resistant to abrasion, yet sufficiently elastic to conform to contraction and expansion of the support Both the primer and the paint can be applied by brushing or spraying

TIRE BLOWOUTS

IN MINIATURE

REATING are blowouts, in miniature. from highway hazards reproduced in the calm and quiet of the testing laboratory, is science's latest technique for combatting heat- rubber's worst enemy. The new technique, helping to eliminate the blowouts from millions of tires for tomorrow's high ways and to strengthen countless other fu ture rubber products, is made possible by a novel testing device

Conceived by B F Goodrich Company technicians, the machine, which is shown on our cover this month, simulates the hun dreds of gruelling impacts, the thousands of jarring vibrations which bombard tires during every minute of service life

The amount of heat built up by tires



Miniature tire blowout created by the machine shown on front cover

under various conditions is charted by the machine using tiny cylinders of rubber about as thick and half as long as your little finger, or equally small blocks of rubber and fabric, as test samples

These sample "tres," each cut out of finished tire tread compounds or careas-constructions, are pounded with 1800 im pacts a minute until the inside rubber is changed by the intense fleat to a liquid and gaseous mass which blows out

Already rubber compounders are converting technical data from tests on the machine, known as the Goodrich Flexometer, into sturdier and safer tires and other finished rubber goods

LONGEST BELT

CONTRACT for manufacture of the longest beliconveyor system ever in stalled (96 miles, from Reddings to Coram chifforns) for use in connection with construction of Shasta Dam, has been awarded the Goodyear Tree & Rubber Company and currently is in process of production in visual control of the Coodyear Tree & Rubber Company and currently is in process of production in visual control of the Company of the Com

The Golumbas pols will require approximately 20 miles of 36-meh wide, as rayl, long staple cotton, rubber-covered belting, weighing approximately 1.500 g000 pounds. It will be installed in 26 endless, vulcanized in 6 miles, vulcanized for a continuous haul of sand and gravel up to aix-nich tobble from the Columbas Company's gravel pits at Redding to the working area for the Shasta Dam as Dam at Coram Shasta Dam as being constructed as part of the federal flood control project for the Creat Central Valley of California, to harness the waters of the Nearamento Reverse

sacrametic twiver. Roughly following the general contour of the rolling desert intervening between Redding and Coram, the belt conveyor will begin its hauf at an elevation of 490 few. 1900 per page 187 per page 18

The conveyor system will be erected on



Expical conveyor belt installation such as that described on this page

wooden bents varying in height above the ground from four to 90 feet and will require the use of 12,500 steel troughing idlers. The 26 terminals, at which links of the system overlap, will be of combination steel and wood construction. Dumping toon one unit to another at the 25 transfer

points will employ the use of steel chuites. The 26 links of the system each will be motivated with 200 horsepower electric motors, except the three most northern units which will generate power because they are down-grade, or lowering conveyors. The component weight of the material on the slope makes these belts self operating.

Slope makes these neits sett operating.

Capacity of the system will be 1100 tons

per hour while conveying at a speed of

550 feet per minute. Material in transit

will be on the conveyor one hour and 40

minutes between extremities. Four vears

of operation will be required to meet the

total requirements of the dam construction

project, estimated at 10 0000,000 tons.

LABELS PRINTED

ON GLASS

B-AUTY is combined with utility in the new Anigraphic Process for printing labels on glass. With this process, existing product labels may be duplicated with exact fidelity of detail and color combinations, or they may be applied without a

background so that the contents of the container will show through the label. Am graphed labels may be washed and are resistant to ordinary solvents and abrasion

The new process is similar to lithography and is applied with a press directly to the surface of the container in one, two, three, or four colors in perfect register at one operation. When the container is placed in an own a moderate temperature fixes the misk, and the container is then ready to use

RAZOR BLADES

A SINGLE ton of high-carbon, cold-rolled strip steel will produce a million safety razor blades

NEW DIVISION OF LIVING WORLD

PROPOSED

TilE old classical division of the world for living things into the plant and animal kingdoms should be revised, Dr. Herbert F. Copeland of Sacramento Junior College recently told a Botanical Society of America meeting.

Proposals put forward by Dr Copeland included the setting up of two new "king



Artist's sketch of the long conveyor belt being installed at Shasta Dam, California

dorsa." One, including bacteria and certain other lower forms known as the bluegreen algae, he would call lite Monera, a term coined in the 19th Century by the German biologist Haeckel. The second, to include lungs and the red and brown algae, he would entitle the Protista.—Science Servac.

PHOTOGRAPHING

MESOTRONS AT

IT is interesting to note one of the services which superchargers are rendering in scientific research. A Douglas DC 3 transport surplane, operated by United Airlines,

officers are familiar with its operations. Yet the supercharger today is extremely simple because an automatic regulator maintains ease level pressure in the air supplied to the carbureter up to the "critical" altitude of 25,000 feet. The pilot merely sets the turbe regulator control to the desired pressure on a manifold gage, and then controls the engine by means of the throttle in quite conventional, fashion.

Essentially, the turbo supercharger is a gas turbine coupled directly to a centrifugal precompressor. The gases in the exhaust manifold of the engine are well above atmospheric pressure (even at sea level) and have a tremendously high temperature. Thus they contain a tremendous amount of energy. The exhaust gase-expand to

System, Inc. (with Richard T. Crane as president, and Bernt Balchen, noted pilotexplorer, as consultant) is applying to the Civil Aeronauties Authority for a Certificate of Convenience and Necessity permitting operation with airmail, passengers, and express to serve 34 cities in 15 eastern. northern, and southern states on a route of 2906 miles. Many of these cities-Bridgeport, Elmira, Syracuse, Knoxville, and so on-have hitherto not enjoyed air service. The new arrive is so laid as not to dunlicate existing services and to feed into the main arrlines. Nothing will be more helpful to the extension of American air transport facilities -A K



W E recently described the experiments to be made by the Forest Service of the Department of Agriculture in dioping fire lighters by parachute. These periments, conducted in the Chelan Naturally recent and the "made in the periments of the control of the contro

The forest fighting 'chutes are 30 feet in diameter (much bigger than the ordinary 'chute) and descend at only 12 feet per second With this slow rate of descent. and flaps which permit the chute to be guided, a jumper can select his landing spot comfortably. Even at altitudes of 8000 feet, where the thinner air gives less support, there is very little hazard in landing Parachute jumpers who had been fearful of the prospect of landing among tree branches were surprised to find that trees, located close together, acted somewhat as springs to cushion the landing and are proferable to hard, rough ground Rips and tears seldom occur in the silk canopy, and there were no instances of a canopy catching, then slipping, and finally dropping through the trees. In other words, either the jumper comes straight through to the ground, or he is held securely suspended as shown in one of our photographs

The standard type parachute-harness



Equipment for photographing cosmic rays at high altitudes

equipped with supercharged Pratt & Whitney engines, recently and unwittingly broke the world's altitude record for the type of aircraft by flying to a height of 28,900 feet It carried two scientists of the University of Chicago, engaged in photographing mesotrons, the heavy radioactive con ponents of cosmic rays. The plane remained aloft for three hours and a half with the outside temperature at 30 degrees below zero, Fahrenheit. The two scientists used 800 pounds of equipment, photographic plates were exposed at the highest point of the flight As can be seen from our photograph, occupants were quite comfortable without overcoats, but had to wear oxygen masks.

The flight was part of the cosmic-ray investigations being carried on by Dr Arthur H Compton, Nobel prize winner, who maintained contact with the plane by radio.—A K.

OPERATING THE TURBO SUPERCHARGER

WRITING in the Air Corps News
tester, Captain Donald J. Keirn presents some interesting thoughts on the airplane supercharger and its operation. While
the airplane supercharger is at least 20
years old, it has so far been installed on
only a comparatively small number of Army
planes, and only a minority of Air Corps
planes, and only a minority of Air Corps

three or four times their original volume and done to the atmosphere pressure of or the altitude at which the engine is operating. In so doing, thev attitud a twhich the engine is operating. In so doing, thever attitudes a 1000 revolutions per minute turbine at 2000 revolutions per minute. The centrifugal compressor coupled to the truthine categories the rarefeel are of high slutted and the power of the engine is altitude and the power of the engine is

thereoy manuants Why is there the "critical" alutude mentoned above? Because the power of the calcular disease in manual particular constant. The gage reading of the centrifugal compressor becomes very low at 25,000 feet. With constant power and decreasing load, the turbos super-tharger would recolve at a dangerously high speed and, to prevent this be by-gased, and less power given to the turbos. Then the compressor receives less power than the power of the engine, contain the power of the engine, contain the power of the engine, contain turberto, begins to drop off fairly randly. A. M. The control of the engine, contain turberto, begins to drop off fairly randly.

AIRLINE FEEDER SYSTEM

THE airmall pick up system recently deteribed in Scientific American is one means of extending the benefits of air transport to small cities and towns. Airline feeder systems is another. Therefore, it is gratifying to learn that Airline Feeder



hoto by U.S. Forest Service Parachute jumper wearing protective suit and helmet, and carrying 'chute and coil of landing rope



Photo by U.S. Forest Service

A "smoke jumper" preparing to disengage himself from his parachute
harness and descend to the ground

proved a handicap in tree landing. When a man hangs suspended from the crown of a tree, the pressure on the leg and chest straps of an ordinary harms: so so great that he is unable to usuang the connections and get free. Therefore, the harmses has been made so that it can be detached from the shroud here. When a man se caught in the strap of the strap of the strap of the child and reaches the ground by a rope which he carries—4. A.

SHOULDER

SAFETY BELTS

RECORDS of accidents suffered by Air Corps plots recently recealed a larger number of injuries to the head and face than to other parts of the body. The reason is that the laptype safety belt prevents the lower part of the body from being the part of the property of the

In appearance, the shoulder asfety belt resembles a pair of vospenders. The front ends are latched to the standard lap type asfety belt, the back ends are anchored to the arriplane seat. The shoulder belt can be loosened or tightened separately from the lap belt, but, when desired, lap and shoulder belts can be released amultaneously.

Laboratory tests have proved more than satisfactory. The pilot's adjustable seat, with pilot mit, was suspended in a horrmontal position from an overhead beam. Through a trip mechanism, the seat could be dropped a predetermined distance and abrupply stopped in its fall by means of a chain suspension. An accelerometer a chain suspension An accelerometer of the trip of the province of the state. pounds, it was Captain Harry C. Armstrong. Director of the Physiological Research Laissneary at Wright Field, who was the human gaines ago in a number of drops he felt the slight cutting action from the edges of the lap belt but experienced no pain or discomfort. On the basis of these tests, it is estimated that an enormous impact deceleration of 30 times gravity would cause no injury to the pilot. If service tests are as favorable as experimental tests, the solution below the solution of the discount of the pilot. The pil

FIRE-FIGHTING AT

THE magnificant North Beach Airport.
La Guarda Field, has been splendedly described and illustrated in the daily press.
There is one item of the equipment, however, which has passed relatively unnoticed with the property of the property o

hoses in the form of gas to smother, within

a few seconds, gasoline or oil flames fol-

lowing a crash. The principle of unothering fire with carbon densitie gas has been upon the control of the con

A CURTISS

NAVY SCOUT

THE XS03C-1, a two-ester scott and to observation plane built for the Navy by Curius Wright, has passed its tests in excellent fashion and has attracted favor-able attration. It is equipped with the 12-cylinder Farichild Rangar "Y" engine, which is inverted and arroaded. But a stort while ago, the radial arroaded object when the subserved in the resolution of the resolu



Fighting a plane fire with CO2 and (bottom) new airport fire-fighting truck

In spite of the moderate power of the Ranger (in the light of modern standards). the Curtiss machine has high performance and long range, for a scaplane of the observation variety. The central main float is braced to the streamlined fuselage by a single cantilever strut The tip floats, which provide lateral stability in the water, are also supported with a minimum of bracing. In addition to fine lines everywhere, a "mid-wing" is employed, that is a wing which is placed neither at the top of the fuselage nor at the bottom. The "midwing" involves some difficulty in the "carry through" of the loads between the wings on each side, but also provides the best aerodynamic solution

While the experimental aircraft is a seaplane, the float system is interchangeable with a landing gear. Such observation machines are now aboard Navy battleships and cruisers.—A. K.

STAINLESS STEEL COINS

PROPER acknowledgement and thanks should be due from the Italian Government to one of our readers, Mr John H Pearce of Seattle, Washington Mr Pearce suggested back in 1932-and we published his suggestion in full-that stainless steel coms should prove far more satisfactory, for a great number of reasons, than coins of other metals usually used Among other advantages of the stainless metal, our article said that it would be as cheap as, or cheaper than, the copper that now goes into our cent, that it would not corrode no matter how long it is hoarded in the child's bank or handled with perspiring hands, that it would wear longer because it is harder, and that it would leave no disagreeable odor on the hands.

So far as our records show, Mr Pearce's suggestion was the first such ever made, and now the Italian Covernment's use of



stainless steel to make come as the first such use. Several new Italian come made of the metal include the following preces: 20 and 50 centissimos, and the I and 2 hre pieces. The special type of stainless steel used contains 22 percent ethromium, 12 percent nickel, and a small amount of molybdenum.

PRUNING TOOLS SPREAD SYCAMORE DISEASE

THE disease of the Lundon plane tree and native syemnors, now a killing spidentic in Philadelpiak and Baltuners, can be introduced into even very small wounds in bealthy trees, by pruning tools, according to seats by Dr. I. M. Waher of the Division of Forest Phology, Bureau of Plant Industry. The London plane, commonly called a systamore in this country, differs from next trees is that it grows well in oldica. The planetice elisees was far noticed in



High performance and long range are features of the XSO3C-1 Navy scout

Philadelphia, and has been found in New Jersey, Washington, Virginia, North Carolina, West Virginia, and Mississippi.

Doctor Walter urges special care—by tree surgeons and others pruning and caring for trees—in the careful disinfection of tools before they are used again on healthy trees Wash the tools in alcohol, he says. While the disease occurs in the large cities chiefly on the London plane tree, it has been found elsewhere in smaller towns on the American

Small samples of living or recently killed wood taken from suspected trees and showing brownsh, reddish, or blush black discoloration may be sent to the Laboratory of Forest Pathology, Morristown, New Jersey, for determination of the disease.

AIR CONDITIONING

MORE than 2000 industrial air conditioning installations are not only improving the health and efficiency of employees but are also increasing production, reducing loss by rejections, and eliminating dirt and abnormal moisture in many manufactured products.

ALUMINUM FILM PREVENTS SILICOSIS

DENTIFICATION of a film which, by covering quarts particles, prevents slicosis, was recently reported by L. H. Germer and K. H. Storks of the Bell Telephono Laboratories in Industrial and Engineering Chemistry.

The protective film is hydrated oxide of aluminum, and is so thin that no way exists of making it visible. Its identity was discovered by electron diffraction analysis, in which a beam of electrons was passed through the film specimen and the resulting diffraction pattern recorded on a photographic plate. Features of the pattern were

then examined to identify the material composing the film.

Silcoss develops rather quickly in rabits exposed to air containing moderate concentrations of quartz particles finer than one two thousandth of a centimeter, but it is completely prevented if aluminum powder as also present in the air to the extent of about 1 percent by weight of the quarts powder. The aluminum forms, in the lungs, a protective film upon the surface of silicos particles which prevents them from dispatched to the prevent them from dispatched to the prevents them from the prevents them from the prevents them from the prevents the

solving, and thus prevents toxic effects. "The seriousness of silicosis in the mining and foundry industries indicates the im portance of adeatification of this film," it is declared "The smallness of the silica particles and the very small amount of aluminum which is sufficient to cover them with a protective film make it evident that this film is extremely thin. It is estimated that a film 250 Angstrom units, or one fortythousandth of a nullimeter, thick will certainly prevent solution of silica and toxic effects The minimum thickness of film which will prevent solution is probably very many times less than this figure.

SNOW PHOTOS

From Air

DOMES of carbon-black powder, dropped on the snow from the map-making planes of the third Antarctic Expedition, will permit faster and more accurate over-lapping of aerual photographs necessary in claiming rights to Antarctic areas by the United States. A large quantity of uncompressed carbon-black powder to be used for that purpose has been donated to the Experiment of the Continental Carbon Competent.

Both the plane carried aton the roof of the huge Snow Cruiser and the planes based at "Luttle America" will carry the blackpowder bombs on their aerals survey flights. Every few miles, just prior to taking a photograph, the planes will release a powder bomb which makes a big black splotch on the snow. When the photographs of the barren wastes are developed, the black apots on the pictures will provide an accurate and quick method of piccing them together to form the acrial map.

Spotting of the ice and snow fields in this manner is necessary because there are practically no landmarks to identify a particular area—nothing but endless wastes of perpetual whiteness.

STREET LIGHTING

EVALUATOR

DEVELOPMENT of an ingenious instrument which, for the first time, enables safety authorities quickly, conveniently, and accurately to evaluate the effectiveness of street lighting systems has just been announced by General Electric's lamp department at Nole Park.

Its aignificance derives from its relation to the 5000 lives that are annually lost in traffic accidents merely because motorists could not see safely Experts to whom the new instrument has been shown hall it as an effective tool for diagnosing street lighting systems and presenting the means of affording adequate visibility.

The new street lighting evaluator serves as a traveling laboratory B. "sees" and promptly records the true brightness of payment, brightness of objects on and near the roadway, and the innerference with seein geaused by the glate from the lighting system. These are the three factors that tauly a driver can see II permits the afety official to determine visibility values without having to step out of his countries.

One of the evaluator's several parts, mounted on the hood of an automobile and extending beyond the radiator, resembles a stubby spring board. A second part, above the windshield, looks like the loud speaker of a public address system. A third element, on the driver's seat, resembles a portable radio.

What appears to be a spring board actually a ministure strip of street. The pavement is similar in tone and tetrure to the surface of the roadway in question. On it are typical obstacles. Its position above the headlamps of approaching cars makes it possible for the investigator to proceed with an appraisal at any time without waiting until traffic host disappraisal.

What first might be taken to be a loud speaker above the windshield is really a

glare collector which measures the total glare from all street lamps, within the driver's field of view, and the loss of vision resulting therefrom.

What looks like a portable radio on the divers' seat as an "operatio" control lox" provided with dals and selector switches the attention of the statement of the three factors (brightness of pavenent, objects, and interference with secting caused by glare from the system) only a few moments are required for the operator to compute the net visibility at a syven location.

RAPID LETTERING SET

A FAST, accurate, versatile and economical lettering set has been announced by the Eugene Dietzgen Company. An outstanding feature of the Edoc "Spec-Dec" lettering set is that with a single guide, it is possible to produce eight differ



Neat, accurate lettering may be produced with this new device ent types of lettering simply by changing

the setting of the tracer and the pen arm. Each lettering outfit has six different weights of pen points from extra hight to extra bold, thus making 48 different weights of type available. Letters are formed in one continuous movements without shifting the guide, because each character on the guide as complete and in alphabeteral order. Each guide has upper and lower case letters, numerals, and characters. Proper positioning and spacing of letters are made easy by the spacing markers. The guide is precision-built of apecial, durable plantic material.

NAVAL CONSTRUCTION

OUR naval building program, off to so late a start in the opinion of many of us, now seems to be making such rapid strides that in the next few years we will approach reasonably close to an adequate Navy. Latest figures on construction of

naval vessels in this country are appropriate just now when attention is centered upon the extent of our defense forces. On October 1, 1939 four of our new bat-

tleships were already under construction and contracts awarded for four more. Probably the North Carolina will be the first to be launched some time this spring Two aircraft carriers are under construction, one of them having been launched last April. Six light cruisers have been authoried but contracts have been let for only four of them, and construction has begun on none. Three submarines have been launched of the nine under construction, and eight more have been authorized but not begun. Nine destroyers have been launched among the 28 now under construction, while seven more have been authorized but not begun We are also building tenders, mine-weepers, a repair ship fleet tugs, mine layers, and sub chasers, totalling 19 vessels, about half of which are under construction or have been launched and one has not been contracted

FORESTS

POR a number of vears prior to the war. Germany was overesting her forests by 50 percent. That country produces normally only about two thresh of its annual wood requirements, and the present war is, therefore, expected to cut so deeply into German forests that it will take years to replenish them

MOTOR NOISE FINDER

An "industrial atchloscope" for use by a scounter regimeers ergaged in the diagnosis and checking of running machinery has been announced by Eletrical Research Products Inc. Just as a doctor latens to the heart beats of his patient and then charts his condition, so the Recording Frequency Analyzer (as the new device as called) discloses the "sound" condition of motions undergoing test, and records the

results on a graph automatically. The equipment employs frequency analysis by the "sweep" method, using a small drive-motor to actuate the frequency dial which sweeps the whole range of frequencies from 30 to 10,000 cycles per second. With this motor is synchronized another





Two views of street lighting evaluator equipment, showing glare collector and ministure street

motor driving a band of graph paper on which a stylus traces the sound level at each frequency passed. Sharpness of frequency selection from the great variety of sound that the microphone picks up from a whirring machine is assured by crystal filters.

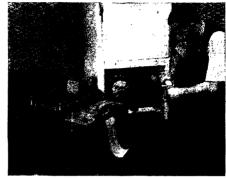
Thus the acoustic engineer has a completely plotted and permanent chart of the sound levels at various frequencies. Having tested both good and defective machines in this manner, the engineer knows the occurric sound peaks at certain frequencies which are symptoms of the defects most chronic to the type of mechane tested. He may then recommend that the manufacturer install nor of the recently amounted Industrial Noise Analyzers for electrical Unit activity which, set to the particular frequency which betrays the defect, he-comes a watch-dog against its recurrence.

ONE MILLIONTH

of an Inch

ACCURACY to one millionth of an inch is the answer of roller bearings to the ravages of friction. And it's done with mirrors.

Using a machine so delicate that it must be kept in an air-conditioned room, The



Testing refrigerator unit with recently announced "industrial stethoscope"



Above Equipment for measuring surface roughness to one millionth of an inch. Below. Path of light ray that makes measurements possible



Timken Roller Bearing Company has achieved a new super-finishing process on the metal raceways in which rollers revolve that eliminates irregularities not even visible with a microscope.

Reduced to its fundamentals, this instrument consists of a light beam reflected hetween a series of mirrors, the first of which is hinged and changes its vertical angle as the specimen is drawn along under it. This is accomplished by mounting this mirror on a bell craft lever privated in the center, with a diamond point on one arm and the mirror on the other.

mirror on the other.

As that damond point makes contact with the specimen surface, any minute zircuplating moves the mirror system. This movement is transferred by the mirror strength to the property of the control of the control

When the paper is developed, irregularities of a millionth of an inch show up like saw teeth. The machine is so sensitive that if the specimen is 000025 of an inch off level, it will show up as an error of 1/8 meh on the sensitized paper.

The direct result of profilograph studies has been a new type of surface finishing Hence, houng mathines were developed. This consists of fine alreaves being held highly against a piece of work, with the highly against a piece of work, with the work moving in several opposing directions. Houng has unquestionable high of the procession bearings by practically eliminating in trual fraction.

TRAIN SPEEDS

THAT the United States has made amazing progress in the speeding up of passenger trains in recent vears can be seen from the fact that, in 1932, American mile-a-minute daily runs totalled only 2022 miles, while today, they have reached 48,247 miles. American railroads also operate 4415 miles at 70 miles or more per hour, and 1012 miles at 75 miles or more per hour.

INFRA-RED SPECTROSCOPY IN

INDUSTRIAL RESEARCH

In recent years a new method of analysis of organic compounds has been put
into practical application. It has been found
possible to use infraved, or heat, radiation
to "finger print" complex organic molecules for identification and analysis. This
method applies only to molecules and is not
to be confused with the well established
spectrum analysis of the elements which
utilities the visible and ultra-volet light
given off by atoms.

The infra-red radiation, sometimes called

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SCIENTIFIC AMERICAN 24 W. 40th St., New York City, N.Y. "black light," used for this purpose is invisible and must be picked up by a very sensitive heat detector, the thermopile, which can "feel" and measure a rise in temperature of only a hundred millionth of a

care matrument known as an infrared spectrometre does the actual "Finger praining" of the molecules. This instrument, the heart of which is a one-pound pram of rock salt, automatically separates the radiation not its various wavelengths and records their intensities. A sample of the organic compound under investigation is placed compound under investigation is placed and the radiation which passes through its measured and recorded by the spectrometer.

measured and recorded by the spectrometer. It has been found that after passing through any given organic compound, the infra-red radiation will have lost a certain set of its wavelengths, resulting in what is called an absorption pattern. The key to the whole matter is that no two different organic compounds have ever been found to have identical absorption patterns.

are interest assessment per send disease. In a construction of an unknown compound simply by comparing its absorption pattern with the patterns of known compounds. The task is ended when a perfect match is found A more important use of the method is the identification of compounds which are present as importine in other compounds. This with very successfully by the new method in a large number of cases.

Perhaps even more important is the fact that accurate quantitative determination of the amount of impurity in a component can be made with the infrared spectrom eter. Amounts of impurity in organic ecompounds as small as 001 percent have been detected and measured. Furthermore, a not inconsiderable item to the chemist is that only a few drops of the sample are needed for the analyses and even these few drops can be returned unharmed afterward.

OILDEX AND

L'ACLESNE manufacturing and sales rights for the production and distribution of an oil dilution extractor and an improved type oil filter, companies motor products designed to effect oil and gasoline asyrings and reduce motor maintenance cost, have been acquired by Bridgeport Brass Company Both products are patented and will be sold under the copyrighted names of "Oildet" and "Filters"

Chines and "Filter
Claiming that the ol dilution extractor
is the only device of its kind on the market
today, where dilution citraction and filtration are accomplished, the company declares
that the use of this product in combination
with the oil filter, in addition to provide
substantial oil assimps, has shown consistent
gasoline savings of from 5 to 20 percent, depending on the condition of the motor when
the installation is made, and reduction in
motor maintenance cost by as much as 50

Both the oil dilution extractor and the oil filter are for installation on the automobile and can easily be installed by a competent mechanic in a short time. The Oildex, for example, has an inlet and outlet tube; the inlet line is connected to the crankcase at some point above the oil level. If the car is

MANY STILL ARE NOT AWARE

that there is a companion volume to "Amateur Telescope Making."

"Amateur Telescope Making— Advanced"

OT merely a new edition of the book "Amateur Telescope Making," but a wholly different work for owners of that beginners' book who have absorbed its contents, "Amateur Telescope Making ---Advanced" has 57 chapters, 650 pages, 359 illustrations and over 200,000 words. dealing with advanced mirror technic, flat making, eyepiece work, drives, aluminizing, observatories and many other aspects of the optical hobby. Published 1937.

"Amateur Telescope Making — Advanced"

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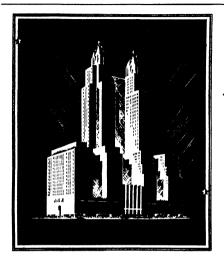
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cessed titanium dioxide, developed by Krebs, which makes practical the use of this pigment in a full line of light-tinted house paints. This new pigment overcomes the tendency of tinted shades to fade when made with pure titanium dioxide, and is more chalk resistant. In addition, paints made with it have exceptional durability and hiding power.

SEALED HEADLAMPS FOR OLDER CARS

DEVELOPMENT of two new all-glass sealed headlamps, designed expressly for use on front bumpers of cars made prior to those equipped regularly with sealed lights- some twenty million in all--was announced recently by General Electric's lamp department, Nela Park The new lamps will be made available early in February One of each is to be installed on a car lumper as shown in one of our illustrations

The new scaled lamps are designed to supplement present headlighting of older cars Proper use of the new all-glass units. according to automotive lighting engineers, will give motorists headlighting approximating that provided by 1940 cars which are equipped with the popular "Scaled Beam" headlamp systems

Like the all glass Sealed Beam lamps on many of the latest models, each of the two new sealed lamps consists of a high efficiency light source, a hard glass reflector mirrored on its inner surface, and a special kins - all parts hermetically sealed into a single unit

One of the new lamps, called the "scaled driving lamp," produces a symmetrical beam of about 35,000 candlepower and, like the "country beam" from Scaled Beam lamps, has a moderate amount of light above the horizontal This beam is intended to supplement the light from upper beams of cars of 1939 and older.

The other new sealed unit, called the "sealed passing lamp," is equipped with a lens especially designed to supplement light from the lower or "meeting beam" from oldstyle headlamps. It provides a wealth of illumination along the right side of the roadway without creating glare for approaching drivers. The beam, rated at 35,000 candiepower, is similar to the "traffic beam" from Sealed Beam headlamps Its light distribution is said to be "asymmetrical," the



Side view of new sealed headlamp for older cars, showing also the connection block on rear of lamp



How sealed headlamps are mounted on the front bumper of older cars

illumination being spread to the right only Nela Park engineers recommend that the sealed driving lamp be wired in such man ner as to come on with the upper beam of the regular headlamps. The passing lamp should be wired to come on with the lower beam of the regular headlamps. Each lamp should be wired through a switch clamped to the dash to permit the driver to turn them off when the car is being driven on lighted city streets

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No Petroleum Shortage

EVER since that eventful day in 1859 when Colonel Edwin L. Drake and 'Uncle Billy" Smith discovered that petroleum could be brought from the earth by drilling, persons throughout the nation have expressed the belief that netroleum resources soon would be exhausted. Even during years when the industry had a surplus rather than a deficiency of oil, revivals of these alarms were heard. Today, despite the fact that proved oil reserves are conceded to be well over 100 percent greater than estimates of a decade and a half ago, alarmists not only insist that they soon will be exhausted but in some instances have charged the in dustry with unnecessary waste and an unwillingness to co-operate in conservation

As a result of the frequent charges of waste, the American Petroleum Institute. in 1925, made a thorough study of the industry and conservatively reported the known future oil reserves as 5,321,000,000 barrels During the next 10 years 8,692,000,-000 barrels were produced, yet authorities agree that today we have future proved reserves of some 17,000,000,000 barrels-more than three and one half times the estimates of the mid-twenties!

But that is not all! During the past few years science, technology, and the inventive mind of man have so widened our horizon that those most familiar with the subject believe that reserves still to be located and developed are much greater than ever

cetimated. The last 10 years rightfully may be termed "a decade of advancement." Engineering advancements have resulted in improved production methods by which increased recovery is possible. In addition, better engineering practices and geological advancements have permitted more accurate determinations of the location and the quan-

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tity of oil in the earth and the industry is vitally concerned in securing the greatest recovery from every pool.

While means of increasing the recovery of oil fields were being developed, better refung methods for increasing recovering of the most valuable oil fractions were found. Thus, today it is possible to give assurance that known reserves, plus the development of those certain to be located at a future date, plus substitutes, should they ever be required, are ample to meet every demand.

Any discussion of the future adequacy of petroleum products should begin with the probable future demand. This is dependent on the nation's probable gain in population, the increase in the number of motor cars, and the requirements for petroleum products by industry and in the home

To make a fair analysis of what is to come during the next several decades, one first must consider the probable increase in population from 122,000,000 to an estimated 145,000,000 Turing this same span, the number of passenger velocities is expected to increase from 25,000,000 to some 3,000,000 and the number of motor trucks and buses will alter from 4,300,000 to some 6,000,000 In other words, the anticipated mumber of motor vehicles in 1966 will be

37,100,000 as compared to 29,500,000 today. From this, one might hastily conclude that the consumption of petroleum products for use in motor vehicles will skyrocket within the next few years Such, however, will not be the case According to reliable authorities, the annual motor fuel consumption per vehicle operated in the United States has decreased from an all time high of 721 gallons in 1937 to 704 gallons in 1938 This reduction in gasoline consumption is a result of the trend to lighter vehicles powered by more efficient engines. and automotive engineers predict that future advancements will reduce the per-vehicle consumption of gasoline to the neighborhood of 670 gallons in 1960

In addition to motor fuel, the harrel of crude of 20 years bence will commune to be drawn upon for domestic demands of kernes, lubricatin, marine and Desel fuels, heating oils, and other uses. Weighing the probable crude supplies from domestic sources against expected demands, it seem that the probability of the peak will be received a place of the peak will be received as the peak will be received by 1960, it is abelieved that this demand will drop to in the neighborhood of 10/10/00/000 barrels—a figure which closely approximates that of today's crude-oil production.

In any far discussion of the subject, one man that is a mind that refinery improvements already in operation and those which will come as a result of unending research will come as a result of unending research in refinery technology and operation will increase the yield of gasoline obtainable from a barrel of crude. Conservative estimates for 1900 indicate that nearly 60 percent of the crude will be converted into motor fuel as compared with slightly over cent of the crude will be converted into motor fuel as compared with slightly over 0.9 percent, the recent average for the in-

Because of the discoveries which have been made and which will continue to be made in the flading, production, and refining of crude, it is quite evident that a shortage of petroleum is renote. Known reserves of today are well over 100 percent greater than estimates of 1925. Properly minused. as in most instances they are today, these reserves, together with new discoveries, are sufficient to relieve any doubt that a shortage of petroleum is imminent—The Orange Disc Magazine.

ALUMINUM ROOFS

A STUDY of the performance of alumnum finishes as applied to metals and other surfaces has convinced engineers that this metal would on resent intense sunlight and condation that it should make a highly suitable roofing material. Hence the Parafinio Companies, Inc., have developed a new roofing called Alumi Shield which takes advantage of the well-known characteristic of aluminum. It has high reflective properties and provide good insulation partible in tests. This new roofing consists of prepared asphalt roll roofing consists of prepared asphalt roll roofing surfaced with metallic adumnum.

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MOLES, BIRTHMARKS AND CANCER

THE common mole, skin-colored or a little darker, "rarely, if ever, terminates in (ancer. and blood-vessel birthmarks and the dark brown, warty, harry birthmarks are also relatively innocent of cancerous tendencies, Dr Eugene F. Traub, of New York City declared at the recent meeting of the American Academy of Derma tology and Syphilology.

"The smooth, dark brown or dark blue marks, devoid of hair, are the ones that are most dangerous. It is from this type that melanoma (serious skin cancer) often develops" he said

Skin cancers, Dr Traub emphasized, are easy for the doctor to diagnose and generally can be cured by X-ray or radium treatment or surgical operation -- Science Service.

DWARF APPLE TREES

DWARF apple tree that will not grow A DWARF apple tree that will not give taller than a man can reach and which will bear fruit the first or second year after it is planted is now a practical accomplishment and should meet an increasing demand among amateur gardeners and home owners, savs Dr II B Tukey, horticulturist at the State Experiment Station at Geneva, New York, who cites the many inquiries received at the Station as an indication of the mounting interest in trees of this type as ornamentals and novelties for the home garden.

"Fortunately," says Dr Tukey, "tests made at the Experiment Station have now

progressed to the point where we can g direct answers to such questions as 'How soon will dwarf trees come into bearing?, 'How big will they get?,' 'What kind of fruit will they bear?,' 'What varieties shall I use?,' 'What special care must I give them?

"The trees which are now becoming available are true dwarfs and are produced by budding the desired variety on a rootstock known to nurserymen as 'Malling IX'. These trees are especially well suited for training to special shapes, many varieties will bear the first year and the rest the second year, and while they should not be



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Converters

regarded as trees to produce the family supply of apples, they make exceedingly attractive ornamentals and often the bloom alone is sufficient to repay the planter for his time and labor."

Dwarf trees should be regarded as garden plants and will require much the same careful handling as do other garden plants, says Dr Tukey, who concludes that, "for the amateur gardener and small home owner, however, they are exceptional, useful, and interesting novelties."

PHOTOGRAPHIC DRAWING

MANY years ago a considerable propor-tion of the illustrations used in newspapers were made by drawing over photographs and then removing the photograph from beneath the drawn lines by means of chemicals. Thus, while the process is not new, it has now been made available for



From photo to drawing

extremely easy operation by the layman in a small kit recently produced by Chas M Higgins & Co, Inc This mexpensive kit contains the necessary chemicals, a bottle of brown India ink and one of black India ink, mixing bottles, brush, a pen, and even a sample photograph on which to experiment

This kit is not, however, wholly a hobby ist's outfit. It can be made use of by editors who wish to make from a photograph a line cut instead of a more expensive half tone An architect, in preparing for alterations in a house, may draw part of the house on an old photograph and then sketch in the desired changes. Other uses may suggest themselves to readers

STAINPROOF PAINT

INTERIOR house painters are plagued with the problem of old stains showing through new coats of paint. Only too often it is necessary to put several coats of paint over such stains, with the possibility that the stain will later make its way through these coats and show up again Staincure is a new paint made to solve this problem It is a ready mixed, white, flat, sealing paint with extremely high hiding power It is, furthermore, quick drying

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than 83 percent, was described recently by Arnold H. Vey, traffic engineer of the State of New Jersey.

New Jersey took a popular four-lane highway and split it down the middle, moving separate concrete slabs sideways Two roadways, separated by a dividing center strip, thus resulted

A study of accident figures on this road in 1933 34, before the division, and for 1937-38, after the division, showed that fatal accidents dropped 83.3 percent Nonfatal accidents decreased 48.5 percent and accidents involving property damage were cut 176 percent The reduction for accidents of all kinds was 404 percent

Particularly valuable was the new divided highway at night, for accidents were then decreased by 47.2 percent while during the day they dropped only 314 percent

The cost for the unique jacking job was \$50,000 per mile, Mr Vey reported. By applying National Safety Council figures to the reduction in accidents, it was found that the saving in accident costs are sufficient to pay for the conversion in slightly over three years -Science Service.

SELF CLEANING COMB

WHAT is said to be the first basic improvement in combs in 4000 years, a new one, called Komatic, has been placed on the market In this comb the backbone



has been pushed completely to one side so that the teeth slots go all the way to the back edge Its self-cleaning characteristic is said to be due to the fact that this side backbone gives a sharp edge on one side and there are no pockets in which hairs or lint may collect.

PROBLEM: THE CHORD AND ARC

HERE is another of Lieutenant-Com-mander Kaplan's headaches for those and there are a lot of them-who really enjoy headaches and claim the problems don't make heads ache hard enough. Find the radius r of the circle in which a

24' chord subtends a 25' arc.

For those who find the problem too elementary, the additional one is offered to deduce a series which defines the radius r explicitly in terms of the chord c and the arc a-a series, that is, which will permit numerical computation of r by direct substitution of the known values of c and a.

In transmitting the above problem, Commander Kaplan underlined the word "explicitly" in red ink, and then stated in his letter that the emphasis was put on the word in order to forestall a deluge of series which define the unknown radius implicitly.



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Well, that ought to be explicit enough, speaking explicitly!

Address any correspondence regarding



this problem to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40 St., New York, N. Y. to whom it will be forwarded unopened.

SOLUTION TO THE

PROBLEM OF THE SOUARE

LAST month we suggested that you try
to construct by graphical means a
square having three corners at distances of 1, 2, and 21's inches from a point within the square, also compute the length of a side of the square Here we have our solution.

Referring to the illustration it will be casy to follow the construction First lay off



one inch lengths, measured from the vertex, along the sides of a right angle. From these points as centers, swing arcs with 2 and 21/2 inch radi. The line connecting the in tersection of these arcs and the vertex of the right angle is one side of the square

To determine the length of a side, we have the following expressions derived from the cosmo law

$$25/4 = Z' + 1 - 2Z\cos\theta$$

 $4 = Z' + 1 - 2Z\cos\Phi$

where Z is the unknown side of the square, and 6 and \$\phi\$ are respectively the angles opposite the 21/2 and 2-inch sides in the triangles shown in the graphical construction.

The equations may be rewritten as 4Z' - 21 = 8Z co •θ

4Z' - 12 = 8Zsin6 Squaring each side and adding gives 32 Z⁴ - 328 Z² + 585 = 0 Solving as a quadratic in Z', we have $Z^2 = \frac{328 \pm \sqrt{(328)^2 - (4)(32)(585)}}{2}$

$$= \frac{1}{4} \left(41 \pm \sqrt{511} \right)$$

and so Z = 28197 or 1.5164 inches. The first of these two values is the correct answer, the latter being the length of a side of a square with the three corners at the given distances from a point outside the square

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OLD SIGHTS-

New Sights

HAD the finilock muskets of our Colonal troops, entreached on Bunker Hill in June, 1775, been equipped with modern sights, that famous command "Don't shoot until you can see the whites of their eyes" might have had neven more devastating and a considerably earlier effect on the Redeoist storming the American ramparts Actually, sights, so called, were in evidence on fire-arms as early as 1175, but it remained for Maurice, of Orange, to make his mark in history in 1598 by designating muskets with sights for the army of the Netherlands

Although development of "rom" sights for hunting riles has advanced apace during the past 60 years to the point where scentified details and data are legion, the great great-grandfathers of many of our present day sights are to be found on an event weapons of European make. Why the early arms were so equipped: something of a puzzle, for, after all, about the best a would-be markinan could do with one of these early games were so equipped: who then of these early games was to point and hope, which was the case with many early games, a true aim as we know it today was almost a mirzacle.

and the was almost a united to the control of the common some of the antique firetime in the possession of II international Studies AC Corporation, foreign and the control of the AC Corporation, the control of the co

The fore runner of the buckhorn sight was found on a matchlock arquebus of 1583, originally made for Francis II, Duke of Saxe Lauenberg Incidentally, this weapon is considered one of the finest antique of this type and is valued at about \$5000 The ancestor of the folding leaf rear sight came to light on a Hungarian wheel-lock arquebus made by Johann Stiffter in 1682. Stiffter is recognized as one of the finest of early gunsmiths, and this sight consists of three leaves, offering various stages of elevation.

On a matterback requires of probable of the control of the control of probable of probable of probable of probable of probable of the control of the control of course, and is mirely an original metal of course, and is mirely an original metal the 18½ inches long with a 3.88 and drame-ter at the buttend, tapered to a 5.732 inch original metal original probable of the control of t

The peep sight we examined was startling, to say the least. It took the form of a four-legged metal hizard, lying on the top of the barrel, with open mouth gaping directly into the shooter's eye. However, the lizard



Left Folding leaf sight of 1682. Right. Ancestor of buckhorn sight.

has a hole through the top of its head, and when one peers through this physical defect, he sights along the gun over a crude head fore sight and hopes his aim will be bettered. This combination matchlock and wheel lock gun was of Oriental origin, 1650.

One requirement of the modern rear peep sight for target use is an arrangement for an eye cup, or a series of eye cups, so that different sizes of apertures may be used. This is accomplished by carrying a gradu-



Left. Variable aperture peep sight made in 1746. Either rectangular or round opening may be used. Right: Fore-runner of the telescopic sight (17th Century)



A hole through the top of the lizard's head serves as a peep sight

ated group of eye cups or through the use of the Merit iris shutter disk. But on a rifle of 1746 we found a sort of pre historic apphoetion of this verienced disk idea in a small metal box, fastened lengthwise of the ton of the barrel. The shooter could sight through a rectangular opening 1/4 by 3/8 inches or he could drop a hinged block of metal into a slot in the metal box and utilize the round aperture 1/16 inch in diameter which had been bored in the hinged block

While the first practical peep sight was made by the Lyman Gun Sight Corporation in 1807, which, with only minor improve ments, is still known as "Lymon No 1, this device for improvement of target shooting did not receive much impetus until after the Civil War and the concurrent Europes military struggles. It was not until 1911, however, that Col Townsend Whelan, in collaboration with other authorities and the lyman people, worked out the first practical micrometer receiver sight, permitting minute adjustment for windage and eleva tion

It remained for Ralph Albertson, of the Merit Gunsight Company, to bring about one of the latest developments in rear peep sights Albertson, a Californian, says he used to "get a big kick" out of hunting the western jack-rabbits on the run with a 22 auto-loading rifle Not having the desired



Left · Variable aperture Merit sight closed and open Right Side view

success at this with conventional open sights, he built a special peep sight and equipped it with a series of eye disks of varying apertures. While these disks were interchangeable without changing zero on the rifle, Albertson decided it was a nuisance to carry a pocketful of accessories, together with canteen, lunch, and gun So, having had many years experience in fine tool and die making, he set about to produce a peep eight equipped with an iris shutter, operaing on the same principle as the diaphragm

of a camera. After several years of experimentation, the Merit iris shutter of today not only answers the problem of variation of sensitivity of individual eyes to light, but also obviates the necessity of carrying a series of disks providing different apertures for different conditions. Merit disks are made for us on Lyman, Redfield, Pacific, Vaver, Marble Gose, Remington, Savage, Winchester, Stevens, and any other sights using 7/32-40 thread for disk mounting and taking a disk 1/2 of an inch or larger in diameter.

GUN COLLECTORS. PLEASE NOTE-

W/HEN we started chatting about antique firearms in the December 1939 issue, we had no idea that we would uncover so many would-be amateur gun collectors among our readers. To those of you who have written for information, we hope the replies have been helpful. To those of you who haven't written and would like to, we say again that our mail box is of very generous proportions. And, to those of our readers who have already es tablished themselves as collectors of old guns, may we suggest that for the benefit of the many neophytes who aspire to reach your status you drop us a line, giving any suggestions you may have which might be helpful in starting a collection of antique firearms !

There are, of course, two primary factors in establishing collections of any items, be they weapons or scrap iron, learn to know the various types or specimens together with their values, and, advertise vourself For the first, there are books, current periodicals, catalogs of amateur and professional collectors, and association with fellow addicts. For the second, Charles Edward Chapel summed it up nicely when, in his book, "Gun Collecting," he wrote, "-to start building a gun collection, look in old attics and barns, visit the junk shops and second hand dealers, tell your friends and relatives you are a gun collector, and write to all the gun dealers for their price lists and catalogs

We can furnish you with lists of books and periodicals, tell you where to write for catalogs, and provide you with names of associations of amateur collectors. We may be able to answer questions concerning ancient firearms, as we have access to sev eral sources of information, and we'll be more than glad to act as a sort of clearing house between those collectors who have obtained a start and those who thus far have only the idea and the ambition. May we hear from you "old timers"? Perhaps some of the newer collectors would like to effect trades or make nutchases

Pot-Shots

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POSITIVE-NEGATIVE

AS except body knows, apper negatives may he had from paper postures (punts) in exactly the same way as photographic prints are made from regular find negatives, either by contact printing or by projection in an enlarger We shall not now take up the subject of making prints by the paper negative process, as our sole purpose is to show how photographic designs either for murals or less ambittions uses may be scheme both the positive and the negative protest.

The subject chosen for the design here illustrated is that of a lynx photographed between two bars of its cage in a New York zoo The pose of the subject-looking toward one side of the picture rather than straight ahead-suggested the possibility of a design in which a number of prints would be made by enlargement, followed by the making of an equal number projected in reverse This latter would have necessitated projecting the negative image with the "glass" or back side toward the easel instead of the normal emulsion to-easel position Thus, when mounted, lynx would face lynx all through the pattern However, this did not seem to offer much promise as it suggested the possibility of dull monotony.

The next thought was to make positive lynx face negative lynx, in this way retaining the original idea yet varying the visual appeal by alternating the tonal appearance of the positive with the distinctively different negative print. The result, we believe, has justified the means

For the purpose of our illustration, we used the dimensions 3 by 214 inches for the print, but the size you select, should you decide to do something along these lines, would depend on the purpose to which you intend to put the design. The larger the space you will want to cover the greater will be the size of the print. It is suggested, however, that the smaller these prints are, for any given space area, the better will be the general pattern effect. A large number of small prints will be more effective than a smaller number of larger prints In the latter case the observer will be so taken up with studying the individual prints that he will fail to get an impression of the pattern as a whole.

After the required number of prints had been made up, washed and dired, one of the prints was selected for making the paper negatives by means of contact printing. We say one of the prints, actually any one of the prints was as good as the next one for this purpose, since one of the important things to look out for in this type of work is that all the prints should be uniform in set that all the prints should be uniform in



Decerative scheme using positives and negatives in diagonal design



Positive (left) and negative prints used in the wall decoration, slightly reduced

appearance--exposed and developed for exactly the same length of time The positive prints had been exposed "bleed" fashion, that is, without showing any white borders, to exactly the required dimensions, so when contact paper negatives were made, they were exact duplicates of the positives in their outside dimensions.

The mounting of the positives and negatives proved to be the most fascinating part of the job Desiring a black background we used a sheet of black bristol board, which was ideal for the purpose We allowed a quarter of an inch from top and side and ruled these off in pencil to provide a guide for starting the mounting of the pictures from the top horizontal row and the extreme left-hand vertical row. From there on we spaced the prints about 1/2 of an inch apart Incidentally, a few extra positives and negatives were printed as a precaution against possible spoilage. The edges were lined up as nearly as possible to maintain the %-inch separation throughout However, in a handmade proposition of this kind exactness is not to be expected nor is its lack of much psequence. Reasonable exactness is all that one can hope for.

The arrangement of the prints is very mple: positive faces negative throughout. Positives and negatives run diagonally through the pattern, but no positive is ever strictly adjacent, that is, above or below or to either side of a positive; and the same holds for the negatives. This may be seen by studying the reduced reproduction shown

If a small area is to be covered, we would suggest making all the necessary prints and negatives directly In the case of a larger area, however, it may prove labor saving to make a small panel, copy it and from this copy make any desired number of prints, which will be joined to cover the designated

PRICES COME DOWN

DRICES of imported cameras naturally soared when war was declared, due to ulties of obtaining adequate supplies. Now, however, according to Burleigh Brooks, well-known importer of cameras, several large shipments have been received from abroad and prices of his line of equip-ment have been reduced to points approximating those in effect before September 5. In some cases, the new prices are even lower than before that date. The lines of fected by this readjustment include Roller. Dolly, Foth Derby, and Bee-Bee cameras, as well as Schneider lenses

HIGH CONTRAST SUBJECTS

ON those occasions when pictures are desired or must be taken under lighting conditions not sufficiently well balanced to come within the range of tones capable of being recorded by a film emulsion, it is still possible to make a satisfactory job by proper development. Pictures taken at night outdoors are one type; another type in cludes subjects involving both dark and very bright objects. An effective method is to develop the negative in a formula from which the hydroquinone has been omitted This formula is usually referred to as metal developer because of its soft-working qualities and its ability to bring out the shadows in a negative Hydroquinone, which favors contrast, having been left out, the highlights come up more gradually than they would with the regular metol hydroquinone combination, thus giving the metal an opportunity to produce full shadow detail without the danger of harsh highlights.

COUNTING SECONDS

FOR short exposures under the enlarger. it is difficult and somewhat bothersome to watch the darkroom clock Anything under five seconds duration is hard to follow without holding the clock in the hand Therefore, most workers when desiring or obliged to make very short exposures in enlarging resort to the "mumbling" system, repeating at an even pace some two-syllable word which, when coupled with the numher of the second, takes just about one second to say. One worker will use Lindy 1, Lindy 2, and so on, another will choose a different word. The word used does not matter, of course, just so it does the trick.

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fairly simple to work on but a black one often appears almost hopeless. What the present suggestion does is to provide a small white area instead of the black line or spot. Make up the following solution:

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CLOSE-UPS FROM

THE HAND

WHEN shooting at such short range as a foot or so, while employing a closeup lens attachment, not only is the focusing very critical, but, after measuring the appropriate distance, not everyone is able to keep the measured distance while holding the camera in the hand We recently had accessor to use a ministure camera equipped with a supplementary close-up lens wanted to use it in the field and did not wish to be bothered with a tripod since the camera was to be used in daylight only. With the lens mount fully drawn out, the distance from lens to object was 15 inches; with the distance scale on infinity, the lens to object separation was 11 inches. We solved the difficulty simply by cutting a twig 11 inches long and another 15 inches long. In operation, all we had to do was set one end of the stick near the lens, and the other end next to the small subject, being careful, of course, not to include the stick in the picture

WHAT'S NEW

In Photographic Equipment

Of you are interested in any of the stems described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request.

Massirita Sincii Soutitios Coton Tostas (41955 for assorted kit.) New kit package includes a bottle of each colorbition provided to tone hundreds of 8 by 10ionly prints. Procedure Print to be toned in submerged in diluted toning solution where toning action may be wateful, when desired color is reached, print is remised for washing to ole-m highlights. Manufacturers say: "Amiteurs who would like to experment with tomic of the processing of the solution of the processing of the processing of so on. Simples of all four colors for 35 cents."

Acra Maso Senzeux (21450) Designed and fitted for use with Agfa 35mm Menocamera Similar in design and construction to Mendelsubin Speedgun Provides accurate synchronization at all camera speeds and with all types fisch lamps Provision made for extension wring to additional flash lamps, safety catch to prevent accidental Exposures; additional distribution of the control of the co

F.R. Percision Rance Finors (black, \$5; chronium finals, \$5.75). Distance meter for amateur still and move cameras. Shows in large, lummous field two separate and distinct images when range finder is not in focus. When smaller image is in exact synchronization with larger image through manipulation of micrometer humbscrew, meter is in exact focus. Works from two feet to infinite.

SPENCEM MODEL MK DELINEASCOPES (22/25) to \$55.50; Croup includes models using 200-wat, 200-wat, and 300-wat bulbs Protection from heat provided by adequate venilitation system in 100-wat; model; heat-shorting giase in 200-wat; and fan cooling attachment plus heat-shorting giase in 200-wat; and fan cooling attachment plus heat-shorting giase in 200-wat; and fan cooling attachment plus heat-shorting giase in 200-wat; and control of the printiling early account hou blue or undensing lenses. Condensing lenses easily removed for cleaning. Also available: Flim jevening

device for viewing strips of films preparatory to making up individual sides Fancooling unit operated by universal motor for 115-vol. alternating or direct current with the site to control speed of fan. Spencer projection lens of five inch focal length, apriture 1/36. Delineascope using 100-watt built designed for home use. 200-watt and 300-watt models for small auditoriums and

DeJin Amsco Chrome Satin Finish Rance Finder (\$550 complete with sling, gen unto leather case, and accessory clips) Utilizes superimposition image principle Has extending viewing eyepitee Focusing achieved by incrometer ball bearing adjuster revolving in bronze bearing. Will fit all cameras

CORD Type BRAQUETTE (\$1). Framing de vice adjustable from one inch to 36 inches--"large enough to hang a mural" All aluminum or assorted in black, red or gold

LAFAYETE SUPERIOR EASEL (\$459) Base olsteel, with rubber strip bottom Finish olstee heard with chrome time, except for 11 by 14-inch focusing surface, which is white Lumishte hordered by inch scales Masking guides easily adjusted and locked, alignment maintained by guide frame at "free" ends

KODAK CONTROL FOR PHOTOFLOOD LAMPS (\$4.50) Designed to prolong life of lamps and assure comfort for subjects while picture is being arranged Compact metal box less than six inches square Control accomodates up to six No 1 Photofloods or up to three No 2 Photofloods Plugs into any power line of 100 to 125 volts, either AC or DC, four sockets provided Lamps may be burned at about half voltage through use of "dim" switch setting, when heat and glare are greatly reduced Either left hand or right hand group of lights can be turned on or off independently of opposite groups With control at camera position, photogra pher can shut off or alter lighting without moving from lamp to lamp

FOTOCRAFT STIDE FILE (\$3.25) Made of seasoned wood, natural finish Capacity 80 two by two-inch glass slides. Has self-contained illuminated viewer operated with button switch.

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For Don's "Baby" was what his friends called the fine, expensive film-pack cemera he scrimped and aswed to get. It was "sepa" in precision picture-making — and mill it. It has a fast Testar leas and a submitted of the separate of the property of the separate of the package of the property of the package of the separate of the package of the separate of the package of the separate of the separate

But a few years ago Don "went cendid" He got himself a costly minicam. And that was when "Baby" languished on the shelf With his minicam. Don could focus few, take action shorts in rapid sequence. He felt very modern But he missed those "manised" negarives—those real prictures with

Then one day Don met a newsphotographer, and tried sighting through the slim, sleek focusing device, on the side of his big filmpack and cut film camera

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So down came "Baby" from the shelf—and pronto Don want to the nearest Kalard deeler to have a range finder put on it Navo Don's minicam gets used for occasional "insp-shooting." But, it's "Baby" that has crept back into Don's beart It's "Baby" Don takes along to get the pictures he really

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AAOB DESCHIN, conductor of our "Commer Angles" department, will answer in these columns questions of exercit interest to anitate upon raphers. If an answer is desired by mail, enclose a stamped, addressed encolope, Queries should be typerfice, but MP Destina cannot under the total rapher of the processed of particular of the purchase of equipment or materials—The Edition.

O. I have a number of two-inch squares of 1/8-inch crystal plate glass, and intend constructing filters, using gelatin films and Canada balsam in the usual method of construction. However, I am in the dark regarding certain details of the process: Chemical catalogs list Canada balsam in the following varieties: natural, paper filtered, dissolved in benzol, dissolved in xylol-extra thick neutral. Which shall I use? Should the balsam and glass be warmed? Is light or heavy pressure used in clamping the glass plates? What is the length of the drying period? Is it necessary to seal the edges against moisture? If so, what is used? -R. J. B.

A Clean—that is, natural—canada halman is specified for this purpose. The balsiam may be used at ordinary thomac temperature, but the control of the control of the control to the control of the control of the control to the control of the say under pressure Dying under ordinary away under pressure Dying under ordinary temperature will take about two weeks The edges should be sealed in some way to prewent the early of mosture Thin adheave such as that used in binding two inch square color allows about serve the currons.

Q. In consulting the speed ratings of various films, I notice that the rating for the same film when used in artificial light is usually slower than it is for daylight. Can you tell me the reason for this?—J. L. G.

A. As you probably know, film emulsions are more sensitive to blue than to any other color of the spectrum. Sunlight is rich in blue rays, but tungsten light sources lean towards the red A comparatively greater exposure is therefore required for the same film used under tungsten lighting conditions to compensate for the illuminant's deficiency in blue. The extent of this deficiency varies with different film emulsions.

Q. I have a miniature camera which takes 35mm film; this comes in small metal containers. In the course of taking the film out of the container, it becomes scratched; how can this be prevented?—J. W.

A. We presume that you refer to the storage of the negative roll in the metal

container. The raw film, as you know, is well wrapped him, as you know, is well wrapped headed shaving the extra protection of a few sheets of literature around it is for as the negative roll is concerned, as the state of the

Q. With a lead pencil I have drawn a rectangle on the ground glass of my camera to indicate the limits of the exposed area of negatives. Can you suggest a better instrument or material for marking on ground glass something that will make a darker mark and will adhere well under working conditions?—F. S. D.

A Lead pencil markings will naturally rub off in a short time Professionals often mark or rule the ground glass with a sharp marker or rule the ground glass with a sharp marker in the in we. Another way is oue black drawing mk, but the disadvantage of this that, unless your lines are to indicate the extreme borders of the film dimensions, the black lines maght interfere with your image, if you washed to work outside the marked limits

Q. Will you please send us a formula for simple photographic emulsion?—J. V. M., Jr.

A. E. J. Wall, in his "The Dictionary of Photography," cities the following Abney formula for an emulsion for rapid plates Potassium bronide... 5 grains Potassium bronide... 135 grains Nelson's No. 1 Photographic

Nelson's No 1 Photographic Gelatine . 30 grains Silver nitrate . 175 grains

(equal parts) 140 grains
For details, we suggest consulting Mr
Wall's "Dettonary" as well as his standard
work on the subject, "Photographic Emulsions," and Abney's "Instruction in Photography."

Hard gelatine and No 1 gelatine

Q. I should like to know where I may find reliable instructions for simple "direct positive development."

A. Write to the Eastman Kodak Company, Rochester, New York, for information on the processing of their Positype paper.



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A G. I.

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

MOST observatory buildings for telescopes fall into two general categories the conventional dome and the opentopped rectangular building Examples of each are shown in illustrations on the present page

The volume of an observatory done is directly propriousal to the cube of the length of the telescope it houses, hence when B I. Bradley, 235 North tight Steet. Salem, Oregon, made a 12½° nutro of 0/11½°, with a 12′ into F (Fagure 2). the 22′ done he built (Figure 1) was a logical exequitie. It is a fine, room dome, quite unlike some which leave so little room between walls and telescope that a far man, or even a skinny one, must become a contortions to note to get a root of the contraction of the contr

Bradley's dome has a fixed base 7' high, of reinforced concrete 5" thick. Rafters are



Figure 1: Bradley's big dome

two-by fours, roofing is 26-gage galvanized iron painted with aluminum. Shutters open a full 6', running on roller-skate wheels. Dome rolls around on ball-bearing assembles from wrecked cars.

The telescope stands on a heavy, deep concerte pullar. Its monuting has Timken and New Departure bearings, a closely each hearted declination circle, electric lights, and other trimmings. Time is 14" in doameter. I mater is a 6", 1/55 reflecting, telescope. Bit offers got the machine work of the monuting done on the well-known, "you seratch my back and I'll scatch yours," principle. That is, he made the last of the Salem High School an 8" mirror while they did thus part of the work for hind the

N winter, the user of a telescope likes a In winter, the user of a consequence of warmth to which he may occasionally flee, while in summer he may want to fice from the astronomer's enemy, the mosquito Frederick C. Holtz, 2150 Wiggins Ave., Springfield, Ill., has worked out a combination, shown in part in Figure 3, which provides for both "The general appearance," he states, "is that of a garden house with a flat roof. The roof is supported on rails and can be rolled back, giving a clear view of the heavens. This has the added advantage of quickly equalizing the temperatures and does away with the turbulance frequently observed when looking through the sht of the hemispherical type



Figure 2 The long-focus reflector

of dome. Many other advantages will also occur to those who have had experience with both types. There has been many an all-night argument between exponents of the two views, it's like that other problem which are better—blondes or brunettes?—in final analysis is nobuble—Ed.

Continuing, Holtz savs. "The portion over which the roof rests when the observatory is in use has been made into a screened-in porch which provides ample room for entertaining guests while they wait their time to view the celestial wonders. This is augmented by an outdoor fireplace which provides hot dogs and coffee to keep out the

cold

"The telescope (Figure 4) is a 6" refractor constructed by the writer." Bolts adds, which ultimately will be replaced by a 20" reflector—though it must be said for the refractor that its fine definition and many good points could hardly be improved upon 1 have made a 3", a 4", and this 6" refractor, also two 8" reflectors, one with quartz mirror.

Holtz says Steinheil and Conrady are his bibles, likewise Hastings' "Principles in Geometrical Optics," which he calls a wonder of a book.



Figure 3: Stars-with-Hot-Dogs, Inc.

UNCOMMONLY trim workmanship is made by D Everett Taylor, 191 Prospect Street, Williamste, Connecticut, the author of the chapter on the construction of the metal parts of a refracting telescope in "Amature Telescope Making—Advanced." Other Taylor jobs—eyepieves, for example —have here deerneed in this department Now, at our request, Taylor describes one of his recent pures of workmanship, as followed.

"On page 242, 'ATMA,' Haviland shows a spherometer, and on page 250 he recommends a dial indicating edge or thickness gage These two items of his are directly responsible for my making the combined spherometer and edge gage shown in three aspects in Figures 5, 6, and 7 For those who aim at a high degree of accuracy in making a lens, this combined instrument demonstrates itself as a necessity instead of 'almost a necessity. The edge of the thickness gage is for measuring the edge thickness of a lens, while the spherometer gives the sagitta or depth of curve, in decimals of an inch, and is used in connection with the two formulas from page 243, 'ATMA' combination gage is made of a 3 5/8" x 3/8" brass disk, 3/4" stainless steel rods, and 1" x 9/16" brass rod holder clamps The Starrett dial gage is graduated to 0.0005", with a side bezel which simplifies lifting the dial spindle at top. The brass disk is edged, finished on both sides, and a 2" and a 3" V-line circle is machined on the face of the disk. These circles are divided into sixths (60° apart), drilled and tapped with 3/16" x 32 thread The edge of the disk is also drilled and is tapped with the same size thread, the holes 60'



Figure 4: Eye end, 6" refractor

apart and located between or at 30° relative to any hole on the face of the disk. Each rod holder clamp is machined, is drilled for a ¼" rod, threaded for a screw, then split with a thin hack saw.

"The use of steel balls in the 45° tapered depressions has been abandoned. Steel balls are not sufficiently accurate. A variation of 0.0007" has been noted in the di-



Figure 5: Taylor's combined gages



Figure 6 Rear aspect of Figure 5



Figure 7. The spherometer set-up

ameter of a steel ball. Therefore, the tap ered depressions are not required. Three steel posts threaded for the holes in the disk, and having highly polished domes, are used. Each of the radiating rods has one threaded end, while the guide rods have highly polished ends. Used as an edge gage, this device will take lenses from 2" to 6" in diameter.

"Figure 7 shows the instrument set up as a spherometer on a 6" optical flat, and adjusted to zero. To use it as a spherometer, three points of contact should be in line That is, a domed post should be screwed on the under side of the disk, into a hole on a V-line circle at each end of the 2" diameter or 3" diameter, with the spindle of the dial gage passing through the center hole from above, as shown in the photograph. This arrangement locates the three contacts in line, thus giving a reading of greater accuracy than would be obtained if three posts were located 120° apart on a circle, with the apindle in the center. It may facilitate in adjusting the spherometer on a flat if, in addition to the three contacts in line, as just described, a third post is screwed into a hole at either side, to steady the instrument while setting the dial. The extra post is to be removed when the spherometer is being used.

"It is doubtful whether a lens can be brought to a complete polish on a machine, without showing some degree of turned edge; which in equal measure would discount the performance of the finished objective if it were not in some manner elimisted. The late world-famous Alvan Clark declared, on the authority of an old lens

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THE BEGINNER'S CORNER

NO thrill an advanced amateur telescope maker is likely ever to receive will out-thrill the one felt by the povice who, after slaving over his first mirror and perhaps wondering all along whether his really will perform adequately, as others do, discovers the usual success. Anthony Minski, 36 Chadwick St., Paterson, N. J., describes this thrill in a spontaneous letter mailed immediately after such a first preliminary try out "After many trials and tribulations I have at last finished my 6" mirror I placed the glass, still unsilvered, in its tube and with no little trepidation prepared for the worst. I focused on the Sun and, as I did, the orb became more and more distinct; till at last it stood in all its glory, a clean-cut disk. The sunspots stood out sharply And then, when it grew dark, I focused on Juniter, which showed with its tiny satellites in astonishing clarity Saturn, too, focused beautifully. Then I viewed various stars and these stood out as brilliant points of light, the fainter stars tiny pin points in the background Orion's nebula This man showed without blur or haze" must have fallen asleep that night with a happy smile on his face! One place and another, it happens ten times a night as first telescopes are given first try outs this eager anticipation, these dark misgivings, the final subilation.

BOY'S seldom tackle telescope making, and more seldom stick till the finishit s not juvenile work and it requires more



nationce than most youngsters mesess. Now and then however we receive a photograph like the one in these columns, usually from a lad of better-than-average gumption, Rudolf Kohlmeister, 1709 Taraval St., San Francisco, Calif., is the maker of this 6" Newtonian reflector and he writes: "I was II when I started it and it took me from Oct 13, to June 15," Well, Rudolf that is approximately eight months, but we know instances in which grown men have failed to finish their telescope after eight years, though eight weeks is about average for a man "The tube." Kohlmeister continues, "is of heavy cardboard wrapped in canvas. The rest is iron scraps and pipe Grinding and polishing required 54% hours" A boy of 11 who sticks to anything as long as 541/2 hours is likely to get some where some day Your scribe recalls a youngster who similarly stuck, made his telescopes, went through high school and college, and is now a professional astrono-mer. That was John W. Evans, of Mills College, Oakland, California

TELESCOPTICS (Continued from preceding page)

maker, that the outer 10 percent annulus of a lens should not be allowed to function Which is the better practice, to grind the turn-down away or to cover it up?

"If (lark's dictum is followed, the required size of glass blank for a lens would be the same in either case. After doing the fussy work required in centering a lens on a mandrel, to grind off a 10 percent annulus would take probably less time than expected. While this grinding would add to the scratch hazard, it would assure a crusp edge and improve an otherwise perfect lens If the outer 10 percent annulus is to be covered, this should be done with authority and permanence, by machining the inner flange of the cell to the required width or depth.

"It pays handsomely to start with flat, parallel faces on crown and fint blanks These blanks slould be pitched or balsamed into close contact, then precisely edged as a combination, to the desired diameter By grinding the curves on crown or flint so that the edge thickness does not vary more than 0 0005", the optical center of the lens will automatically be established-and probably with greater accuracy-compared with the result of the tedious conventional practice which depends on reflection and visual judgment"

HAVING purchased a 201/2" Pyrex mirror blank, the Springfield (Mass.) Tele-

scope Makers-Carl F Alsing, president, N Main St., N Wilbraham, Mass.- cast about for ways of parallel facing it One of them owned an old safe for which he had no use because he had nothing to keep in it, and this was converted into a steady support for the grinding spindle. Figure 9 shows the disk on this rough rig while its faces were being ground parallel, as it was 3/8" thicker on one edge than the other, and Figure 8 the 20" by 412" finished blank with upper face roughed out to approximately the ultimate focal ratio, or 55. We did the edge with the blank pitched to plywood and mounted up grindstone fashion." Alsing states

N his new book about the 200" telescope, entitled "The Glass Giant of Palomar, David O Woodbury discusses the methods used for rotating observatory domes. At Yerkes and Lowell the domes were pulled around by cables wound on a drum At Mt. Wilson the big dome rests on wheels geared to motors At Palomar, however, there are two pairs of 5 hp motors, one pair of which is shown in Figure 10, a photograph



Figure 8: 20" disk ready for fining



Figure 9. Rough rig for rough work

by Major Martin D McAllister of the Municipal University of Wichita, Wichita, Kansas The vertical drive shafts carry solid rubber truck tires held to the bottom band of the dome by means of springs and friction As shown in Figure 10, they make contact with the dome through a narrow opening in the top band of the fixed base. This dome drive also acts as a brake or clamp for holding the dome, otherwise the



Figure 10: The Palomar dome drive

unbalanced leverage of the opened shutters with a breeze blowing would turn it, even if it does weigh as much as a 12 car train of passenger cars (1000 tons), for the two rings on which it rotates, made of railroad rails, were ground precisely level.

A MONTH ago we hinted here a few facts about the new Gaviola test for optical surfaces Before offering a description of it we propose to wait to see how it shakes down in actual practice in the hands of the average worker. Since it deals in amounts about as much smaller than the ordinary Foucault test as the latter deals in amounts smaller than precision machine work, its use obviously will be confined pretty largely to amateurs who have de veloped high skill. If fine machine work today involves precisions of 1/20,000 of an inch, ordinary mirror work has dealt in precisions of about 1/400,000 of an inch. The Gaviola test deals in precisions of about 1/4,000,000 of an inch. Its user must be expert enough, not alone to perform the measurements, but to control the actual surface in the same degree of precision-all of which hath perhaps a supercilious sound to it. Hence, since the amateur has intellectual curlosity, he will want to know how the new test works, anyway.



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LEGAL HIGH-LIGHTS

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By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

REASSURING

MANY of us will be reassured by the implication inherent in a recent decision of a federal court that manure is not an obvious substitute for or equivalent of cereals. The decision was handed down in a suit for infringement of a patent for propagating mushroom spawn Prior to the invention covered by the patent in suit, mushroom spawn was propagated by placing a culture in a bottle packed with composted manure. The culture was permitted to propagate in the bottle for a period of six weeks or so under predetermined conditions of temperature and humidity. During this period the thread-like mycelium of the culture spread throughout the contents of the bottle. At the end of this period the resultant product was known as mushroom spawn and was planted in properly prepared beds to produce mushrooms

In the process taught by the patent in suit, cereals went as cracked wheat, whole grain wheat, barley, and rye were substituted for the composted manure and in all other resperts the process was carried out in seemtably the same manner as the original process. Among other things it was contribed by the defendant that the substitution of the cereal for the composted manure did not amount to inwrition. The Court, however, found that the use of cereals manure did not decided improvement in the spaws and concluded that the reptreasure by a cereal constituted in-

RECORDINGS

THE Courts have recognized that inter-THE Courts nave recognised from of literary property in their renditions Thus it has been held that where a recording has been made of an orchestra leader's interpretation of a song the recording cannot be broadcas over the radio without the consent of the orchestra leader. This principle of law assumed a peculiar twist in a recent Federal Court decision in a case involving a promi nent manufacturer of phonograph records and a well-known orchestra leader. The orchestra leader had entered into a contract with a manufacturer, granting the man facturer the exclusive rights to manufacture and sell phonograph records of his ren ditions. The contract specifically prohibited the manufacturer from using the records for radio broadcasts. Thereafter, the orchestra leader authorized radio broadcasting stations to broadcast the recordings which were made pursuant to the agreement.

The manufacturer objected to this use of its records and filed suit against the explosive loader and a radio broadcasting coupany to restrain them from using the records in this manner. The Court found that the orchevtra leader "because of his unique interpretation of muscal selections, had a common law property right in his renditions" and found that the property right in the recorded renditions had been sold to the record manufacture. Under the circumstances the Court concluded that the transfer frenditions and could restrain the orthertal renditions and could restrain the orthertal reader and the broadcasting the company from broadcasting the recordings

VELOT

IN this department in the June 1939 issue, under the title "Experimentation," we referred to a decision of a federal court with regard to a parent for propagating the propagation of the propagation

The patent in suit related to a process for propagating yeast in which the production of alcohol was reduced to a minimum. The patent suggested that the yeast be placed in a relatively dilute wort Upon the initiation of the process of reproducti a relatively concentrated wort was added to the original dilute wort over a protracted period of time. The patent did not specify the exact times at which additional concentrated wort was to be added nor did it specify the quantity to be added at these The patent did state that the wort should be added "at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the dilute portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." This description was held by the court to be too vague and indefinite, since both the times and manner in which the solution is to be added may be ascertained solely by experimentation.

THERMOSTATIC

CONTROL

THE difference between a patentable combination and an unpatentable agregation was considered in a recent suit for patent infringenent involving a thermostatically controlled, house heating system. In the patented system, a transce having an automatic stoker was utilized and a thermostatic control was provided in the room to be heated and also in the furance.

The thermostst in the room was of the usual type intended to cause the operation of the stoker so as to maintain the room temperature within certain predetermined limits. The thermostist in the furnace was intended to cause the operation of the stoker to prevent the fire in the furnace from going our, particularly during warm sufficiently from the stoker and the cause operation of the stoker at sufficiently frequent intervals to keep the fire going.

It was contended by the defendant that the use of the two thermostats was an aggregation, as distinguished from a patent able combination The Court considered the law with respect to this question and concluded that "the acid test is whether the old elements work together to accomplish a useful new result " If they do, there is a patentable combination. If they do not, there is merely an unpatentable ag-gregation The Court then pointed out that the two thermostats did work together to perform the function of regulation of the room temperature within predetermined limits. The thermostat in the furnace prevented the fire from going out and in that way enabled the furnace to operate in response to the thermostat in the room and thereby preserve the room at the desired temperature As a result of this co operation, the Court held that the patent covered a patentable combination

HAVANA

PALSE or musleading branding of merchindise is an unfair method of competition and can be restrained by the Federal Trade Commission However, an intreating qualibation of the power of the
Commission to restrain such practices has
been recognized by the courts. Thus, where
a misleading name has been employed by
annulacture for a long period of time so
as to acquire a secondary meaning quite
spart from its outgrained significance, the
courts will not require the user of the
name namediately to discontinue further

This principle is illustrated by a Federal Trade Commission proceedings involving the use of the name "Havana Smokers" on cigars manufactured in the United States from tobacco grown in the United States. The Commission contended that Havana tubacco was regarded as superior tobacco and that the name Havana Smokers would mislead purchasers into believing that the cigars contained Havana tobacco A Federal Circuit Court of Appeals, reviewing the proceedings, found that the name Havana mokers had been used by the cigar manu facturers since 1902 and that in all probability the name had acquired a secondary meaning, quite apart from its original significance, indicating to the public that the cigar was the product of the particular manufacturer In view of this the court was of the opinion that the sudden elimination of the name Havana Smokers might cause confusion among the purchasers of this brand of cigars and concluded that the manufacturer should be allowed a period of two years within which to eliminate the use of the name Havana in con nection with the cigars. In this way it will be seen that the public would ultimately be protected against the use of a misleading brand name and that the manufacturer would be permitted a reasonable transition period within which to adopt a new name

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NINETY-SIXTH YEAR

"Onen House"

ORSON D. MUNN, Editor

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THE peculiar object on our cover is a 16-inch

closed, turret variety, permitting observation from within when winter winds or summer in-

sects bite. It has a massive, slanting, concrete cap that rotates on rolls, carrying with it a diagonal flat mirror (here invisible), a con-

cave mirror at the end of a framework, and a

small opening through which the twice-reflected light rays enter the cozy interior On the nearer

side is a long steel counterbalance. The photo-

graph was taken at Stellafane, mecca of amateur telescope makers, near Springfield, Vermont, by Robert Cox.

astronomical telescope of the Hartness, en-



18988

Questions Answered for the Amateur Photographer Book Reviews 184 Telescoptics 186 Current Bulletin Briefs Legal High-Lights Varicolored Ham and Eggs Vitamin C

NTIFIC AMERICAN, March, 1849 Vol. No. 185, No. 3, entered at the New York, N. Y. Post Office as second class matter June 28, 1878, under the act such 3rd, 1879, additional entry at Orange, Oran Published monthly by Murms & Companio, Line, M. West, 6th Street, New York City Companied 1844 for the Additional Section of the Companied Companied to Develop 1879, and the Companied Section 1879, and the Companied Companied to Companied and Companied to Companied and Companied to Companied and Companied Compa

50 Years Aco in ...



(Condensed From Issues of March, 1890)

REFRIGERATION.—"Our food supply has been largely increaged by the application of apparatus for mechanical refrigerations to the property of the property of the property of the property for former more trade with Vew Zealand is of recent development, and it has already reached normous proportions. At present twenty-seen steamers and ten suling vewels, all fitted with mechanical refringeration machinery, are engaged in this trade."

FIRE BOAT -- "The cuty of Boston has recently built and put into service a fire boat, designed for use as floating fire engine . . .

The pumps . . are of vertical, duplex, double-acting flywheel type. They are divided into two sets, com prising altogether 4 steam cylinders, 10 in by 10 in. and 4 water cultuders of 10 in stroke and 9in diame-In the illustration a good idea is given of the service that such a boat can perform In addition when from her forward deck ander perfect control, a number of lines of hose can be carried from the header, so as to deliver water to en gines on shore Thus the boat is not merely for the



protection of the water front. Much useful service can be executed in a helt 2,000 feet wide around the shore line."

TORPEDO BOATS. "Messrs Yarrow & Co have recently completed six first-class reprode boats of what is now reckoned the standard type. The boats are of galvanized sized and are 130 feet long and 13 feet 6 inches broad. Their triple expansion enginewill indicate about 1,150 bares power, and, with a load of 20 tons on board, will drive the craft at a maximum speed of rather over 23 knots or nearly 20% miles on hour."

AMMONIA FROM AIR—"The production of eyanogen directly from aimospheric mitogen has been made the subject of interinvestigation by F. Birneman. which leads to the conclusion that while counties and aimmonia may be thus produced eyenmentally, there are as yet insuperable difficulties in the way of adapting those methods to industrial purposes.

STILL WANTED—"Those who have spent a half hour or wo trying to ring up a man at the other end of a telephone line, and have found out after much effort that there was no one there, would feel better if there was on the market something which would at one, when a box was rung up, give a signal stating that there was no one to receive a message, and how consenior it some attachment could be devised for communicating the time the person would return to receive the message."

SUEZ—"Night traffic on the Suez Canal has increased very rapidly since electric lighting was started. Thus in 1887 there were in all 371 inght transits made, but in 1889 this number had increased to 2,455 out of a total of 3,420, or upward of 71 percent of the vessele passing through the canal, and four-fifths of the total tonnage, used the electric light to assist them. At the same time the average duration of the passage has been reduced upward of 40 percent." HORSES.—"The horseshow of the present should be improved. There needs to be somehing which will save the hoof from under war and breakage, while at the same time permitting of elasticity of the movement when the weight of the hold is all translety borne upon and taken from it. It is suggested that an improved roudway is needed in that climate, something that will war as well as stone, he as easy to pull on as asphalt and gove the borses' feet a good grup, so hagelies will not slip, even in ratio. Worther?"

ALIMINION. The aluminum industry is on a firm footing both in Europe and America. There have spring up two distinct lines of manufacture, this one a chemical process, and the other strictly metallurgical. The former produces pure aluminum, and continues to be a complicated process demanding skill and patience. The latter produces only the allows of aluminum, and has been made extremely simple.

PILLOWS—"The latest fad in England is paper pillows. The paper is tern into very small pieces, not larger than the finger nal, and then put into a pillow sack of drilling or light toking. They are very cool for hot climates, and much superior to feather pillows. The finer the paper is cut or torn, the lighter it makes the pillow."

WOOD AS FOOD—"In an address delivered at Heidelberg, by ag less emment an authority than Victor Meyer, it is announced that 'we may reasonably hope that chemistry will teach us to make the Bher of wood a source of human food." It must be borne in mind, however, that theory, takenitating and promising though it may be, is not always capable of being followed up by a practical

PHONOGRAPHS. "The Anomate Phonograph Exhibition Compans, of New York City, has been—formed to manufacture, lease, use, and sell a nickel in the slot machine, by means of which the dropping of a com in the slot will operate a mechanism which will cause a phonograph or phonograph graphophone to produce the sound recorded upon its cylinder, and after such reproduction cause the displicagin for return to its original position."

NIAGARA "The Niagara River Hydraulic Tunnel, Power, and Sewer Company will now, it is stated, carry out its plan for utilizing the fall of water at Niagara, by building its main tunnel and connecting cross tunnels with wheel pits."

AND NOW FOR THE FUTURE

Great increases in motor-car mileage will result from developments in gasoline processing. By Dr Graham Edgar.

Maintaining life in persons who cannot eat—By Barclay Moon Newman

fModel railroading (no "toy trains"), a hobby that is creating rapidly growing interest among adults. By R T Griebling.

PLUS other features of wide interest, plus our comprehensive Digest of Science and Industry; plus Camera Angles; plus Telescoptics

Personalities in Science

PROBABLY few scientists have a closer personal acquantance with the reticent and clusive atom than Dr George Russell Harrison, Professor of Physics and Director of the Research Laboratory of Experimental Physics at the Massachusetts Institute of Technol over

Several years ago, Dr. Harrison de cided that the first step toward a closer relationship between pure and applied research in the application of atomic physics to industry was to learn much more about the language and customs of atoms, so that the scientist could distinguish easily among them both tribal ly and individually. As a result of his work, there appeared last fall the first volume of a series of new tables of spectral lines which contains the accurate. necessary data of the 110,000 strongest lines emitted by the chemical elements Data on the fainter lines will appear in subsequent volumes

Speed and accuracy in gathering these data were made possible by two ingenious machines devised by Dr Harrison Although he says modestly that he was driven to these inventions as a



GEORGE R. HARRISON

means of exage from old and tedous methods of achieving the same results, his accomplishments are more the least actional computes the wavelengths of spectrum the least actional miles, while the other, known as the hotter, known as the other known as the computer of atoms and molecule from their spectrum, the energy action at miles and is capable of making the computer of the com

For his "notable work in spectrum photometry and spectrum analysis" Dr Harrison was awarded the Rumford Medals in October 1939, by the American Academy of Arts and Sciences in Booton.

Opposed to the hoarding of scientific knowledge, Dr. Harrison has become a leading interpreter of research. His recent book, "Atoms in Action" is ample proof of his success in the popular interpretation of his work and that of his scientific contemporaries.

Born, raised, and schooled in Southern California, Dr. Harrison was graduated from Stanford University in 1919 He became an instructor in that matture too and continued studies which led to the degree of master of arts in 1920 and doctor of philosophy in 1922. Soon after, he was named National Research Tellow in physics and studied two years at Harvard, after which he returned to the faculty of Stanford as assistant professor, later becoming associate professor.

He joined the stuff of the Massachusetts Institute of Technology in 1930 and became director of the physics research laboratory when it was founded in 1932 During 1930-31, he also served as research associate at Harvard

Dr. Harrison is a fellow of the American Academy of Arts and Sciences, the American Posseal Society to Optical Society of America, and the American Association for the Advancement of Science, and is a member of Sigma Xi, honorary scientific society and American Association for Poisse Teachers He was married in 1926 to Florence Bartram Kent.



PURE SCIENCE TEAMS WITH INDUSTRY

DR John A Hipple, Ir, of the Westinghouse research laboratories, with a new mass spectrometer huilt to not molecules and their constituent atoms according to mass. Its outside portion consists of two hemispheres wound with water-cooled copper conductors designed to carry 300 ampress at 150 volta. The upper half of the coils hoists off. Inside is the actual spectrometer, which employs a vacuum tube in which nonzed particles are differentially sfeeted by the magnetic field Practical applications; Base knowledge necessary in the design and manufacture of fluorescent lamps and mercury-are rectifiers, as well as a noon and argon tubes.



To fight the hookworm science first fights ignorance Hookworms enter the body through the skin of the feet, if bare

SILENT ENEMIES

Until Sanitation Becomes Universal, Man Will Harbor Internal Parasites and Suffer From Them... Worms...Worms...Worms...Inside Us

By BENJAMIN ADELMAN

MAn is a walking hotel in which more than 100 species of parasitic worms reade. These parasites longer in his skin, in his muscles, in his lungs, in his intestines and in his brain, while several kinds awim through his blood Perhaps he is victimized by more worm foes than any other animal, for no other creature reliables so wide a variety of food and drink, roams everywhere over the earth, has such an extensive contact with soil, water, and insects, in which worms lurk

Every country in the world, therefore, is plagued by worm diseases and the United States is not excepted Quite a big fraction of America is wormy. For example, about one million Southerners still have bookworm in spite of a 30-year campaign.

Even more common than hookworm is the well-known disease of trichinosis.

William Wolf in his article, "Animais Bring Us Disease," in the May, 1939, issue of Scientific American, stated that 16,000,000 people in this country are infected with trichina worms. We can't look down on other countries for being worm-ridden.

The strangest class of parasite worms are the tapeworms, and some of the most remarkable tapeworms are found in Americans Consider the "fi-fis" tapeworm, a wriggling, animated tape running to a length of 60 feet. It is not an animal as we understand the term, but a family of 3000 to 4000 individuals or proglottist hat are linked together in a long chain. Each proglottid leads an independent like, contains organs of both sexes and produces eggs all by itself. This monater worm can lay 36,000 eggs a day! The young worms dwell in the flesh of the freshwater fish of the Great

Lakes which are shipped fresh by the millions every vear to cities throughout the country. Probably thousands of people are infected with this dangerous worm, which can easily a serious health menace that has had much too little publicity. Tapeworm infestation is easily diagnosed, even in its early stages, by spotting the eggs or proglotteds in the human wastes and thus the victims can be read if which consideration.

The fish tapeworm is not a native. It was brought in the furnears working in the lumber industry of Canada and the Mid-West Through swage the fish became infected and, since bears, dogs, and otters as well as man cat fish, eradication of the disease is now an impossibility. The best hope of control lies in educating the public to cat only thoroughly cooked fish.

Fish tapeworm infestation, like other tapeworm troubles, is best treated by carbon tetrachloride. One dose of the drug kills 70 to 80 percent of the worms cessor of a long line of anti-heliumthics or worm-killing chemicals. One of the first, dating to the Middle Ages, was male fern Many doctors still use the extract of the roots. The chief disadvantage of male fern as a remedy is that the patient must be starved for 36 hours before being dosed, and few patients are willing to submit to such treatment. Carbon tetrachloride, on the other hand, can often be taken without preparation

Trichinosis and hookworms are very common diseases but they may soon be surpassed in prominence by a littleknown newcomer -- oxygrissis or oin worm infection Pinworms are homeloving parasites fond of bathrooms and fixtures, but for decades doctors dismissed them as a mere children's disease as trifling as chickenpox. Parasitologists knew that the pest was ex tremely prevalent, but for the most part pinworms flourished in safe obscurity until three years ago, when the United States Public Health Service started to investigate thoroughly America's most widespread parasite

Every angle of attack diagnosis, treatment, distribution, and, most important of all, the life history of the creature — was tackled and in three short years enough new facts were unearthed to establish pinworms as a medical problem.

THE first question the Health Service THE first question the Health Service asked was simply, "How many people have pinworms?" Obviously, the whole population couldn't be examined. so the only feasible method was to take samples of the nation and from these estimate the extent of the disease. The Service's experts sampled Washington the Nation's Capital, and discovered that, out of 2091 Washingtonians, 861. or 41 percent, were infested! Since pin worms appear to favor the cities, the rate in the country may be lower but it is possible, although not proved as yet, that pinworms may be far more prevalent than most doctors believe, and let it be remembered that pinworms can cause indigestion, insomnia, constitua tion, and have even been suspected of

inciting appendicitis The ubiquitous pinworm achieves his success, not by hard work, but by a clever bit of strategy which sets him at the head of his class. Other intestinal worms lay their eggs inside the intestine, therefore their eggs are confined to the human wastes and can be distributed only by contact with them. Hookworm is the classic example. The pinworms, contrarily, crawl out of the digestive tract at night, and deposit their eggs on the skin. For as long as ten days the eggs may remain alive and in this period are scattered over clothing, bedclothes furniture, bathroom fixtures, and even dry up and are wafted by the air cur rents to the walls and ceiling! Small

wonder that pinworms run in families!
Yet that's only one difficulty. Give a
hookworm victim an efficient drug which
will rid him of 90 percent of his guests

and he'll usually recover and overpower the rest, but eliminate 90 percent of a punworm victum's paraeftes and the unlucky patient will shortly be as badly off as before — pinworms are persistent.

The most hopeful possibility of conrol fises in repeated treatments. The Public Health Service concluded that a course of daily does for ten days would clear out the parasites and provent reinfection while the pinworm eggs deed out, and, after vegas of research, but upon a very progning drug, tetrachlorethylene, which has cured 91 percent of a group of 122 test cages.

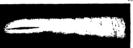
The most terrible parasite in this country, fortunately for the rest of us, is found only in a small group of Ne groes of Charleston, South Carolina These people are the prey of elephantiasis, the horror that swells the limbs or organs until they reach a tremendous size—bence the name.

In India, land of strange sights, elephantiasis sufferers are counted by the thousand. Unlike other worm diseases, elephantiasis is not caused by live worms since the living librarial worms in the patient's blood are harmless. Their corpses do the damage by blocking up the lymph ducts. These swell under pressure.

non. One group suggested that the thyose are hong lived and hide sor where in the merior of the body durf, the day, magrating to the surface & night, but this theory doean't seem very likely. An embryo has about as much chance of remaining in a large artery as a man would have of swimming across the rapids of the St Lawrence River Furthermore, the pattent's blood vessels would eventually become completely congested and his circulation would stop. And fisally, whyshould the embryos hide gloum the prying eres of the educe?

An opposing theory says that all the mother worms give birth at the same time, once a day, every day, and that the infant worms live less than 24 hours. O'Connor found that in the morning the females were filled with embryos while about 2 o'clock all the young had been born. Now, Cule's quinquefasciatus, the





Above A model of the head of T. salum, the common tapeworm from pork Left Model of the head of fish tapeworm. Thorough cooking kills both of these kinds of tapeworms

and then burst, flooding the lymph into various regions of the body. Sometimes the legs become so enlarged that it is impossible to lift them.

Like malaria, vellow fever, and dengue fever, elephantiasis is passed along from present patient to patient-to-When the common be by mosquitoes tropical house mosquito. Culex aumquefasciatus, sucks a sufferer's blood, she swallows a few of the infant filarial worms, creators of elephantiasis. One day, about two weeks later, the mosquito bites another human but this time she gives as well as takes. The larvae slide down its probosers into the bite. One bite is not enough, however. Only heavily infested individuals show symptoms and therefore the disease is confined to localities where many cases live close together

The filarial worms can tell time As a rule the baby worms appear in the blood under the skin from about 10 p m to 4 x m. but are almost completely absent during the day. For 40 years scientists have argued over the why and wherefore of this astonishing phenome-

common tropical house mosquito, which transmits elephantiasis, bites only at night. It seems that the birth of the filarial infants is regulated by the habits of its goffather.

No sure cure for elephantiasis is known Scattering the victims, however, is one method suggested for eradicating the disease.

In western Indus the people are attacked by huge gumes worms because, unstead of drawing up water from their wells, they wade in to fill their jars. The huge three-foot gumes worm lives under the skin, only the very tup of her body protruding into a tiny ulcer. Whenever water touches the ulcer, the worm discharges a flood of embryos which swim right into the mouths of the nearest Cyclops, a tiny crustacean. The native swallows the Cyclops along with his drinking water and another human becomes a alwo of the worms.

At first the patient is nauseous, vomits, feels giddy, has fainting spells. Attempts to extract the worm by native means may lead to blood poisoning, sometimes necessitating amputation. Doctors ex-



Drinworms from a human appendix, magnified 45 diameters. Your grandparents, especially your grandmother, who brought up babies, knew the pinworm ("worms"). Later, worms "went out of families" but now the United State.

Public Health Service has demonstrated that they are not to be laughed at

tract the warm in three sections by aseptic methods. Prevention is even simpler than cure but it will be years before the Indians can be induced not to wade around in their water supply.

In the Bible we read that Moses made the likeness of a "ferr serpent" and wound a stock to aerre as an example to the people of Iarael The Elizabethean scholars who translated the Old Testament plamly dhalt know their biology, for the "ferry serpent" ascitually Dracinculais medianciais, the guines worm. Even today native mediance of the public of the guines worm by winding it would be supported to the guines worm by winding its according to the support as the public of the guines.

HE oddness of worm diseases ex-I tends to the way they have been ferreted out Sir Patrick Manson, the founding father of tropical medicine. once spent several years in China doing medical research One day a Chinese visitor called on him and in the midst of conversation very rudely spat on the floor As Manson stooped to clean up the mess after his caller had left, he noticed that the flecks of saliva were bloody. The excited doctor touched them with a slide, slipped it under a microscope and instantly identified a "new" disease-Paragonimus infestation which sickens millions of poor Chinese and Japanese.

Paragonimus is a half-unch long, leaflike fluke that lives in human lungs, causing coughs, chest pams, and bloodtinged apsum. In fact, lung-fluke infection is usually distinguished from tuberculosis by discovering eggs in the sputum. Drugs are ineffective but transier of the patient to a fluke-free locality easables Nature herself to heal the sufferer in five or sax years. The eggs spat out by the infested man hatch in water and once in a million times the embryo meets a little fresh water anal and burrows into its issues. Passing through three bizarre transformations the voung fluke emerges, crawls over the bottom of the stream or pond until it encounters a fresh-water crab, climbs up and pierces the leg joint, and burress tagle in the leg must les The Chinese and Japanese unfortunately are fond of raw crabs. If they were to give up eating this delicacy, Paragonium; plague might disappear in a decade

A similar disease, caused by liver flukes, also troubles the Chinese. Here the chain of victims rups from carn to man to snail to carp (Only a certain species of snail will do) The willowleaf-shaped, one-inch long parasite lives in the liver bile ducts where it can cause anemia, emaciation, diarrhea, and a fine case of cirrhosus of the liver. Khaw a Japanese parasitologist, found that a dve called gentian violet would safely kill the worms Prevention, of course, is obvious. As a matter of fact, the Chinese peasants themselves show how the discase can be eradicated. The flukes range over most of China yet the disease is confined to the vicinity of the cities of Canton and Swatow, the only districts of China where raw fish is eaten

Eating infested food is just one means of acquiring parasites. In Australia, infested dogs disseminate a gruesome parasite, the Australia instead of the Australia in sheep rancher lost his little daughter because he was foolsh enough to keep hydatid infested sheep dogs. They were dangerous to their masters, even though they weren't vicious, for they carried the seeds of death and these needed only the right environment to start their fatal career. Every

day the dogs played with the little girl until one day she swallowed an invisible white speck, a hydatid egg

Within four hours the egg hatched in the child's intestine and the infant worm penetrated an artery where the blood swept it to the brain in which it stuck fast. The speck grew until it was a holow sphere or cyst the size of a golf ball, result of the size of a golf ball, and the size of a golf ball with the size of a golf ball, and the size of the size of a golf ball, and the size of th

As the months passed, the lattle gat complained of frequent breddens, then of failing eyeught. Later her memory and finally her strength declined. Once a lively, healthy child, she degenerated mito a dill, paralyzed movald. When her desperate parents brought her to the McBourne Children's Hospital, it was too late. She died soon after the operation, a sacribe to human ignorance.

Hydatid cysts normally bulk no larger than an orange but they can expand to huge dimensions. In one case a cyst grew for 43 years until it was as big as a child's head. Another, the "monster" cyst, contained 11 gallons of fluid!

The rarest of all worm infections is also the most starting. Discophymerals, the guant kiney worm, has been found a few times in human beings, in the process of autopsy. The worms usually occur in pairs, the female being about 40 inches long, the male about 10 inches long. They spend their lives in the kidneys, distroying the itsues until only a hollow shell is left and the victim dies of blood poisoning. Pleasant.

AN the parasitic worms be de-Geated? The Rockefeller Foundation thinks so In 1909 the Rockefeller Sanitary Commission was organized for the specific purpose of fighting hookworm in the deep South The Commission made a survey of the hookworm belt and decided that about 2,000,000 Southerners had the worms Within four years they treated 500,000 cases Encouraged by their success, the Foundation extended its effects, establishing the International Health Board in 1913. The Board has fought the war against both germs and parasitic worms in over 30 countries. Their achievements have led to the establishment of national and health departments all over the world. Today in Egypt, in India, in the Philippines, in Africa, even in war-torn China, the doctrine of sanitation which stamps out parasites wherever it is applied, is being taught to the people. Clean food, pure water, cleanly personal habits-all these slash the routes by which the worms gain access to the human body As the great Robert Koch once said, "It is possible for man to wipe out all infectious diseases." Universal sanitation will make Koch's prophecy a reality, for most of mankind has still to achieve a decent standard of cleanliness.

OPEN HOUSE

 \mathbf{M} EN of science of Columbia University recently staged an "Open House" session, to which the public was invited to inspect the various laboratories. Through the courtes of Science Observer, official organ of The American Institute Science and Engineering Clubs, we reproduce on this page illustrations of some of the more spectacular laboratory equipment that was demonstrated

Right Rear view of the Pupus expectors in the Pupus Physics Laboratory. This tool of science is used to produce beams of high-posed sons which, when they arrise targets of various materials, produce effects that give physicists mew insights into the problems of atomic structure and behavior. With cyclotrons, transmutation of elements has been achieved, and radio-activity has been synthetized





Determination of the forces necessary to shatter wooden posts (for example) gives data of value to construction engineers and others. The machine shown above, capable of exerting a force of 600,000 pounds, is splintering an eight- by eight-inch fir post at a pressure of 155,000 pounds

Below With the ultra-centrifuge it is possible to subject small quantities of maternals to immense stresses and to study photographically the effects. The rotor of the centrifuge is supported on, and driven by a current of air and can be revolved at tacks a specific property are also as the study of the property are also as the study of property are also as the study of property are also as the property and the property and are also as the proper



Right A torsion machine in the Civil Engineering Laboratories determines how much twisting a piece of material will take before it breaks or loses its elasticity. Bars, rods, or flat strips of any material may be subjected to torsional stress, the indicator showing the load spulled Left In a sub-basement, mounted on bedrock to eliminate vibration, is a small piece of equipment built with the same accuracy as is observed in the construction of fine watches It is used to test the value of lubricants in the following manner A measured coating of lubricant to be tested is transferred to the surface of a polished metal disk from an absolutely level surface of water where the lubricant has been allowed to spread into a layer one molecule thick A ball-shaped sapphire is now carefully adjusted on the oil layer that covers the metal disk and the disk is rotated. Pressure is applied to the sapphire ball until friction causes the ball to drug. When this happens, an indicator on the machine registers the fact. From the data so obtained can be calculated an index of lubricating properties of the oil



OUR POINT OF VIEW

Whose Fault is it?

I N an outstandingly notable discussion of "The Scientist in an Incientific Society," published in our June, 1934, number, Secretary of Agriculture Wallace raised a question which since then has been the subject of a great deal of debate in scientific circles. The question was "whether science, having demonstrated its power to transform the world, ought not have some responsibility, or at the very less, some interest of the second section of the sectio

Science, according to Mr. Wallace, proceeds without moral obligation, and is neither moral nor immoral, "if should like in the fine of the

From one of our readers, Mr Arthur Jobson, has come a letter which, though not so intended, constitutes essentially an editorial reply to these arguments. We turn the column over to Mr Jobson

"Nearly six years have passed since Secretary Wallace's challenge to the scientist," he writes, "and, while this time is brief compared with the slow processes of social evolution. there has been time for the matter to ripen somewhat in our minds That his views are still held by many laymen is evi dent. As an instance, I recall the comments of a noted news paper writer who visited the New York World's Fair last year. This man said, in substance, that everything is there which demonstrates how man, with his capacity for precision and beauty, retains a preposterous incapacity to enjoy the fruits of his genius- to be as wise as he is intelligent, and to be as good as he is great Though he has learned to do the vector analysis in mathematical physics, he cannot add and subtract in political economy. He can calculate the fine ness of a machine to a millionth of an inch, but he cannot bal ance a government budget. The general implication is that science is much to blame for this, as Secretary Wallace has

"Being an engineer and somewhat of a scientist myself." Mr. Johan continues, "I am dren amused at these outbursts It is of course galling to think of the great advancement we have made in science, invention and engineering while we have made so sorry a mess of our economic life; but these critics seem to forget that in matters dealing with a social system we are confronted always by the vagaries of humanity, entirely remote from the scientific approach. The politician and would-be social reformer, having failed to put our economy in order, tend to clutch at a straw. They reason that, since the exact mind of the scientist has attained great suc case in his chosen field, why shouldn't he he able to cure our social lile?

"I have a feeling that this would be impossible—this Utopia in the affairs of men. It cannot be done, for surely it would mean the most exacting kind of totalitarian state. "No government can rise higher than its source. So long as a this source is contaminated by human traits, we must expect the social body to suffer. The man trained in science, on endeavoring to correct this situation, would find most of his efforts of little avail, for he is vastly outnumbered by the rest of the normalism."

In our opinion, Mr. Johson his the nail on the head science can plend and urge, but until man can remake bis nature, the sciencial view of the source of the source, the scientist's hands are practically tred. He is like an individual in a big long of habonos, who occasionally discovers choice morsels his chances of retaining control of those morsels is about on a par with the chances of the famous Celluloid dog. Nevertheless, he is essaying a start. Knowing well that he has no effectual direct way to hold off the other habons, he has organized groups, both in this country and in Britain, for the study of indirect ways. These consist essentially of education and moral persuasion. Nothing stronger can be envisioned. And thus all he has to do is make a clean sweep of the three human lusts for power, prestige, possession. A large order!—A. G. 1

Rising Intelligence

QOMETIMES we are a despar for the intelligence of the American people. But not now For years a conferous minority swayed the people with its propaganda for disarmament, and the people would not permit proper naval building programs. The times have now demanded a change of attitude. Before, it looked as though the people would never draw lessons from our past history which shows one war after another without preparedness. Assurance of proper prepared ness to keep us out of war is seen in the current attitude of the American public as well as in present Congressional action. Even the professional pacifists have now taken up the crys for building up our definiess, even as Scientific American believed they would during all the years this magazine was urging that we prepare in times of peace.

Americans are insistent that we stay out of the present war abroad Leaders agree to that dictate whole-heartedly. They agree also to the principle of making our military position as impregnable as possible Hence, with a great naval building program now under way we plan a further one which would increase our Navy by about 25 percent. This will mark a new high point in our naval construction which has moved upward rapidly duruag the last seven years after years of idleness in most of our yards.

Against this background one important fact stands out. That is that navid design did not suffer so much from lack of orderly evolution as most people read into the record merely because we were not actively building shaps. The drafting boards and the towing basin—where hulls are studied—the steam laboratories and general navy research were none of them as idle as the wards. In consequence, we can build ships that are as good as any affoat. Indeed, in some respects, our ships may be superior to the ships of other nations. And there is little doubt that we shall learn other lessons from the present war abroad, which, added to our present naval knowledge, will carry us far toward a navy so superior in design, opera toon, and general efficiency, and so powerful in its aggregate fighting ability that it will tend to prevent unwanted war from descending upon us.

And that brings us back to our first paragraph. The American people want to keep out of war and at last are using their intelligence to prepare in times of peace to make sure that we do keep out—or to assure quick disaster to any who may drag us into war against our will.—F. D. M.

New Engineering In The Navy

THE new ships of various types which have joined the Fleet em body many advances and improve ments in the fields of naval architecture. marine engineering, and naval ordnance The result is increased military effectiveness. Modern warships are perhaps the most ingenious and complicated machines yet produced by man. From this fact it logically follows that any change must be well considered But. in view of the long time required to build naval vessels, there must be a delicate balance between conservatism and adoption of advanced ideas if we are to have the maximum of military efficiency in a new ship when it comes off the building ways. This delicate balance we have striven to maintain

An important factor in this military is efficiency—where such a balance is efficiency—where such a balance is necessary—is the machinery installation. It has been recognized for generations that we could reduce the size of our machinery and increase the size of our machinery and increase the pressure and the temperature of the steam Such increases, however, had to await advances in metallurgy that would provide metals to withstand high-pressure, but the machinery conditions.

The Navy did not make the step to the present steam conditions in one leap, but has advanced in a series of conservative steps, raising pressures from 200 to 300 to 400 to 450, and then to 600 pounds, and increasing the superheat gradually In fact, the last change was only from 600 pounds, 700 degrees, High-Pressure, High-Temperature Steam for Warships... More Reliable Machinery... Greater Speed ... Economical... Equipment for Our New Warships

By CHARLES EDISON

NOW that the United States on a sensible construction program, Secretary Edison's article brings welcome news to Americans. Speed is vital to warships If, on a given hull, more power can be installed, a greater capacity for speed results. If, more over, the machinery is more compact and reliable than before, the result is greater military efficiency in several phases of the ship's design. The Navy is to be commended, therefore, for its persistent attack on the problem of ship power generation and propulsion which has culminated in the development of machinery that gives better speed and economy and is more reliable than older types.- The Editor

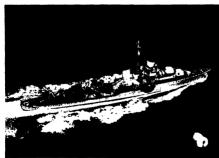
Fahrenheit, to 600 pounds, 850 degrees. Fahrenheit These steps have lagged be hind commercial practice ashore where 1200 pounds and 950 degrees. Fahrenheit, is not at all unusual for new in-

stallations, nevertheless, they have been enormously important, and a portent of others to follow.

One of the first decisave steps taken onnection with the current building program was to serve notice to all propertive bidders that no contract would be awarded for the design or construction of naval vessels that would be out of date the day they were launched due to ultra-conservative design of main machinery and boulers One of the bi-products of this new policy has been to direct the shipbuilding industry of the country toward the development of an all-American design.

N 1933, the Navy Department con IN 1933, the Navy Department of destroyers Into these ships went a distinctive American engineering installation consisting of high-speed turbines, double-reduc tion gears, an improved boiler feed sys tem and a cruising turbine that is constantly in gear The double-reduction gear permits utilization of higher tur bine speeds with attendant increase in efficiency. High turbine speeds have reduced the number of turbine blades by 75 percent and the length of the rotor by 25 percent. The feed water of a modern, high-capacity, boiler installation requires the virtual elimination of oxygen in feed water. Due to the fact that the design was one of the major advances in naval engineering since the introduction of the turbine, some congestion in the engine rooms resulted This design, however, showed an increase in fuel economy of about 25 percent with a corresponding increase in cruising radius. The first of these ships was delivered in 1936 and probably represents the greatest progress the American Navy has made in engineering in a generation.

This class of destroyers—the Mahan class, started in 1934—was followed in rapid succession by other modern destroyers in which were incorporated the same fundamental design features as had appeared in the Mahan, and in addition thereto, superheat control type boilers.



Speedy and highly maneuverable destroyers are vital to fleet actions



Destroyers of the Fleet participating in recent maneuvers held off the California coast

In the fall of 1937, the Somers, one of the destroyer leaders, ran her preliminary trials with exceptional results In comparison with competitive designs she showed an improved economy rang ing it 700 degrees. Fabrichheit The Somers was the first vessel in the Navy to operate at \$50 degrees, Fabrichheit, and when operating at that temperature increased her economy another 10 percent and increased her developed horse power by 10,000. She was the first ship to be equipped with air-encased, sep parately controlled, superheat bollers

As a result of the success with the Somers, all battleships, crusers, and destrovers are being built today to operste at 600 pounds and 850 degrees, Fahrenheit, and so will be all the battleships of the present building program

It is apparently no more difficult to train men to operate the new plants than it was to train them to operate the old ones On recent trials of a destroyer operating at 600 pounds, 850 degrees, Fahrenheit, one of the outstanding comments of all observers concerned the smoothness with which the crew operated that installation and controlled the temperature. In fact, when it was desired to drop the temperature suddenly, on backing, it was changed from 850 degrees, Fahrenheit, to 700 degrees, Fahrenheit, in 40 seconds without difficulty.

The new machinery has been of equal or greater reliability than the old type machinery. This might have been expected, as old factors of safety have been maintained, or even increased, and the general design of high-speed turbines with small, comparatively short rotors, is more rugged. Service with the Fleet, of course, is fairly limited, but reports to date indicate that, as to reliability and maintenance, the new maintenance the new maintenance.

chinery is equal or superior to the old Taking any given ship and operating its machinery under two sets of steam conditions, gives some indication of the relative merits of the two steam. conditions, but that indication is not as clear cut as might be expected. There are two reasons for this. The high-pressure, high-temperature steam goes only to the main propulsion turbines with the possible exception of turbo-generators in some cases The result is that at very low powers, say below 5 percent of full power, the auxiliaries take such a large proportion of the total power generated, that the effect of the highpressure, high-temperature steam in the main turbines is masked Moreover. all turbines at very low powers-for example, below 5 percent of full power-are relatively inefficient and do not reflect much change due to steam conditions Nevertheless, at high powers, where the auxiliaries are not taking such a large proportion of total power gen-erated, and the main turbines are able to take advantage of improved steam conditions, the improvement is shown very clearly

TWO typical examples of such tests were the one of a cruner and of a destroyer. Trails of the cruser were run with saturated steam and then repeated in the same pressure, but with the steam temperature rased about 200 degrees. At very low powers, below 5 percent, there was no appreciable difference on over-all fuel consumption between the two conditions, but at high powers—for example, 60,000 shaft horse-power—this higher steam condition made a saving of 12.2 percent in the fuel consumption fer the ship as a whole.

The destroyer was tested on two steam conditions, namely, 600 pounds pressure in both cases, but 700 degrees, Fahrenheit, temperature in one and 850 degrees, Fahrenheit, in the other Again at very lww powers—below 5 percent—the over-all fuel consumption showed very little improvement, but, on operating at full power, a saving of over 14 percent was effected. In fact, under the higher steam condition the ship actually developed about 10,000 more horse-power than designed at the lower steam condition. This extra 10,000 hove-power would mean that the ship could maintain its battle speed even with very much more bottom fouling than would be possible at the lower steam condition.

A better comparison of the effect of changing machinery and steam conditions is indicated when we consider what would happen if we put the complete machinery from one existing ship into another hull For example, the machinery of either of a certain two of our new destroyers could supply the power of a certain one of our cruisers which though new, did not have such data of both the cruiser and the destrovers indicate clearly that if we should put destroyer type machinery in the cruiser, we could save 18 percent in cubic feet of space and 29 percent in the machinery weights, while making a gain in economy of 13 percent at full power, this gain increasing to 28 percent at a more moderate speed of 10 knots. Moreover, such data as are available indicate that the destroyer machinery is more reliable.

In short, as we have advanced steam condutions, we have developed machinery which is not only more economical, but is elso more reliable and just as easy are concesser, to operate, sanitating after protect in battle. The advances to these conditions have been by short, conservative, well tested steps, and the Navy has gained thereby.

A FAMOUS THEORY WEAKENS

THERE are few more difficult problems than the origin of our planetary system. Its isolation, and the common motion of the Sun and planets through space, practically compel us to suppose that they had a common origin. It is incredible that the many regularities within it— such as the motion of the planets in nearly circular orbits, all in the same direction and in nearly the same plane— can have been the result of accident. We look for some orderly process which might have produced it—but, so far, the inventive skill of a certury of astronomers has

One encouraging hy pothesis after another has been suggested, only to collapse before some simple and unanswerable objection. Most of these, as many of us may remember, were dynamical, and dealt with engular momentum or to paraphrase Newton, the "amount motor" or for totational motion" in the system. No cations between parts of the system, one it is solated, can alter the total amount of this—they can only transfer it from one part to another.

sought in vain

Laplace's original hypothesis was that the system was originally a great nebula, bugger than any of the planetary, orbits and much flattened at the poles by its rotation. As it contracted, it retated faster, and faster, shed a ring of matter at its equator, which gathered into a planet, then later shed another, and so on till the remaining central mass shrank into the Sun.

But, at present, only one part in 60 of the angular momentum is in the Sun's rotation, and the rest in the motion of the planets. No one has ever been able to suggest an orderly process by which, in a system undisturbed from without, more than 98 percent of the angular momentum could get into one seventh of one percent of the mass Moreover, Jeffreys and others have proved that a ring of matter equal in mass to even a large planet like Jupiter, but extending all around its orbit, would not be gathered into a single mass by its gravitation, though it might well break up into a number of small bodies like asteroids

So this hypothesis went into limbo, and another took its place — the en-counter theory. According to this, once upon a time another star, in its course through space, passed by accident very close to the Sun The original form of the hypothesis (due to Chamberlin and Moulton) assumed that the star's attraction released cruptive forces within the Sun which ejected great quantities

The Encounter Theory of the Origin of Planets Has Now Become Shaky and May Pass into the Limbo Where the Old Nebular Hypothesis Went

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson
Observatory of the Carnetic Institution of Washington

of matter, some of which cooled into big masses and the rest into innumerable little ones — "planetesimals" — which were picked up by the bigger ones as they grew into our present planets

Later forms of the hypothesis attributed the expulsion of matter from the Sun to the tidal attraction of the star (Jeans) or to a direct collision between it and the Sun (Jeffreys) The last meets with the fewest dynamical difficulties, and gives us a picture of the two stars separating after the collision, but joined by a "filament" of matter resulting from the intermixture of the parts which actually collided A mixture composed almost wholly of solar material would be moving slowly away from the Sun and later fall back into it. similar material would accompany the star, but there would be some fairly uniformly mixed portions which would not fall back into either one Some of this stuff might escape into space - the rest would be good raw material for planets

Angular momentum again turned out to be a stumbling-block - this time angular momentum per ton of material The ultimate size of a planet's orbit depends on this Calculating it for material knocked off the Sun by a collision, it comes out too small to get a planet even as far away as the Earth. So we seemed to be back where we started. But soon afterward Lyttleton flanked the obstacle by suggesting that the Sun may once have been a double star, and that a visitor from space collided with its companion Under favorable circumstances. the intruder might send the former companion flying off into space by its attraction, without being itself retarded enough to be captured by the Sun, and yet a part of the filament of matter between them might remain within the Sun's sphere of influence and form plan-

THIS gives us planets at any distance from the Sun that we want, and escapes the last difficulty. But Luyten has shown that the conditions required to

let both the former companion of the Sun and the intruding star escape, and yet have planet forming material which did not get away, are extremely difficult to fulfil, and the question is still in debate.

The objections which have so far been raised to the various forms of the encounter theory are purely dynamical. They depend on simple consequences of the law of gravitation, and could have been discussed as intelligently in the days when Neptune was discovered as at present.

But, even if all these difficulties had been fully removed, there would remain others, different in character, but quite as serious. One of these is that the mat ter ejected from the stars, whether by tidal action or collision, must at the start have been extremely hot There 18 no sense in thinking of it as having about the temperature of the Sun's surface A very simple calculation shows that, if enough material to form Jupiter were spread in a uniform layer over the Sun's surface, the pressure at the bottom, due to solar gravity, would be 880,000 atmospheres, and the average pressure throughout the layer half as great At a depth where there was such a pressure, the temperature would also be very high. To estimate it accurately, we would have to know how the outer parts of the Sun were built, but there is no doubt that it must be several hundred thousand degrees If this intensely hot gas were pulled out of the Sun by tidal action, it might be cooled somewhat by expansion, but if it were scraped off by a collision, the friction between the intermingling solar and stellar gases would heat the mixture to a far higher temperature.

If the filament of gas connecting the wo stars remained anything like as hot as this, the velocities of the separate attraction of the ejected matter to hold them back. They would like yeary especially and the gas would disapate itself into space. This has been realized for 60 years. But the

gaseous mass, radiating freely into space, would also cool very rapidly, which would slow up the atomic motions, diminish the internal pressure, and tend toward stability. In this race between expansion and radiation, which would win?

This is a problem not of dynamics, but of physics, and would have been un answerable without the aid of modern knowledge of the laws of gas opacity

If the ejected mass of gas were nearly transparent, so that heat could escapelly freely from its interior as well as from our staturace, it would cool very rapidly — giving out at first a tremendous burst of tempore ultra-volet light, and then set thing down, perhaps to condensation but if we consider such a layer while still in the Sun, we find that radiation can escape directly from only the thin neat kind of surface skin containing less-than a millionth part of its whole mass-

The difficult problem of the behavior of the filament after its formation was attacked for the first time by Dr Spitzer—a National Research Fellow at Har vard—and his results, just published, afford a definite answer.

To get the problem into mathematical by tractable form, he has of course to make simplifying assumptions, treatings with the filament as a uniform cylinder in in shape, and taking average values of the pressure, and so on, in the interior R is possible to handle these approximation—so that we are not getting too small an answer—or too large, of we proceed differently

Working in this way, Spitzer funds that, if no heat were lost by radiation, a filament of 1,500 of the Sun's mass, and a million miles long, would expand into a state in which the separate atoms were flying of los fast that the attraction of the filament could never bring them back in less than three hours. A better approximation, taking account of the fact that the filament must be growing longer as the stars separate, reduces the time to half an hour.

To calculate the sate of cooling is more difficult, but, for the same circular filament as before, it is found that direct escape of heat takes place only from a very thin outer skin, and that, if the filament could be held at its initial size by some imagined force, it would take at least a year to get rid of half its original content of heat.

THE disparity of these two numbers of output that an actual filament of gas would expand so fast that it could never check itself. Iong before cooling produced any perceptible effect. Straning very assumption in favor of the cooling process, Spitzer finds that it must, in the most extreme case, take more than a hundred times longer than the expansion. To assume that the original

THE DISSIPATION OF PLANETARY FILAMENTS 681 t_i , denotes the value of t for which the radial velocity outward, s_i equals the velocity of sscape from the filament, s_m , thin we have $r_m = \int_{t_i}^{t_i} \sigma(t) dt \qquad (7)$ If we neglect δ_{t_i} assume that a_i is constant through time, and replace s_m by its value for a spherical mass M of radius R_i , we find from (5), (6), and (7) that $t_i = t_s = \left(\frac{\rho_m}{r_s}\right)^{\gamma-1} \frac{m\pi_i}{RT_i} \left(\frac{MGR_i}{2}\right)^{\gamma+1} \qquad (8a)$ Substituting $M_i \times R^{\gamma} c_i$ for ρ_m , we have $t_i^{\gamma} = t_s = 1 \text{ or } (s_{i-1})^{\gamma-1} R^{\gamma-1} M^{\gamma-1} t_i^{\gamma} t_i^{\gamma} \text{ sec.}, \quad (8b)$

In his monthly articles on stronomy, Professor Russell unterprets for the average reader many professional papers previously published for the astronomer, hence in mathematical form. Move is a sample of the article behind the present interpretation, from The Astrophysical Journal of land December. The Astrophysical Journal is the containing publication of its kind for American astronomy, paut as the Monthly Voices of the Royal Astronomical Society, on which some portain astronomical papers in the English language are published in one or the other of these two journals. In fact "most" might well read "virtually all"

filament was flat like a ribbon instead of circular in section makes the disparity even greater.

This analysis - the first in which modern physical methods have been applied to the problem -- looks as if it would send all the forms of the encounter theory to Valhalla There is still one unexplored consequence. The filament would fade away by expansion, but the gases of which it had been composed must go somewhere Part of them would fall back into the stars, part, near the middle, would be left wandering as lone ly atoms in "the wind that blows be tween the worlds"; but the rest, and probably a good deal, would settle down into a gaseous atmosphere about the Sun, and another about the retreating star These envelopes would not be held up by pressure from below, like the Earth's atmosphere, they would be in rotation about the Sun - an immense swarm of atomic asteroids, if the phrase may be pardoned - colliding with one another every few hundred miles, bouncing off into new paths, but, as a whole, forming an enduring gaseous shell

Whether such a non-uniformly rotating atmosphere could condense into solid bodies has not yet heen investigated. If it turns out that it could, the encounter theory may yet be revived—for the requisite angular momentum is

It is very hard, though, to see how most of the mass could be concentrated into a single large body which, like Jupiter, is rich in hydrogen. Those atoms or molecules which absorbed sunlight strongly would be driven away at once by radiation pressure; the others, which scattered light weakly, would be subject to the effect worked out by Poynting and Robertson, and would gradually spiral into the Sun But, for such bodies, this action would be slow and there might be time enough for a good deal to happen.

If material enough to form all the planets were distributed uniformly inside a sphere as big as Neptune's orbit, the total amount of matter along a column a square centimeter in cross-section. extending from the center to the edge. would be about a gram It might seem at first that so thin a layer of gas could produce no perceptible effect, but it amounts to a thousandth part of the whole atmosphere of the Earth. Such a layer of gas, illuminated by ordinary sunlight, would scatter 1 1000 as much light as a clear noonday sky, or 500 times as much as a clear sky under full moonlight --- and hence be extremely conspicuous against a really dark background Sunlight at Neptune's distance is approximately 1 '1000 as bright as at the Earth's, but, even under this illumination the shell of gas would appear half as bright as a moonlit sky, and hence far brighter than any ordinary nebula. The Sun, surrounded by such a gaseous envelope, and seen from Alpha Centauri, would appear at the center of a bright nebulosity, fading away gradually at the outside, and about 45 seconds in diameter. The glare of the Sun would probably obscure this on photographs, but it would be conspicuous in a reflecting telescope, with the central star hidden If, however, the heavier atoms and molecules had coalesced into dust particles, the medium might form a fog thick enough to obscure the Sun from points outside it. But, in that case, the effects of light-pressure would appear and it would not last very long -Princeton, December 20, 1939.

DERUTANTE METAL - BERYLLIUM

F beryllium could boast no definite commercial accomplishments, it could still lay claim to a measure of fame. What other metal remained, to the man in the street, little more than a name for a century, only to win prominence overnight by strutting the Washington stage

It is fact that beryllium was hardly known to the general public until hearings before the Temporary National Economic Committee revealed that it was a strategic material of war, that there was jockeying among nations to acquire the secrets of its use, and that Germany led in the race So much was said at the hearings about beryllium as a metal of the juture that one could hardly appraise it as a metal in present commercial use, much less figure out what is required to translate futures into actualities. Now that the coming out party fades from memory, just what is there about this debutante among metals that makes it so important?

Until the Washington hearings, beryl hum was tracing a perfectly normal, if little-known, course. There was its iden tification very long ago - 1797, to be exact Then came its chemical isolation more than a century ago. Like many other elements, it remained a curiosise for decades before its value was recognized Just prior to the great inflation in Germany, the firm of Siemens Halske put a staff of men to work probing this unknown metal, in the correct belief that one of the best ways to preserve capital is to plow it into productive research. That really dates the commercial beginning of beryllium, because at that time was discovered the extraordinary heat-treatable characteristics of berylhum-copper alloys - a discovery of exploited to make beryllium valuable immediate commercial value

OF course, a lot of things had to be discovered to bring beryllium out into the open Methods of recovery had to be devised, because research could not be widespread when only small amounts of the metal were available As recently as 1922, the cost was \$5000 a pound As extraction problems were solved, the price fell steadily to reach today's figure of \$15 As soon as in creasing amounts appeared, researchers undertook to study physical characteris-

The peculiar qualities that recommend beryllium at this stage in its development are. light weight - it is lighter than aluminum: durability, fatigue resistance; and a strong affinity for oxygen Large Supplies . . . Makes Extremely Hard Alloys of Copper. Other Metals . . . Low Percentage is Needed . . . Research Finding New Alloys, New Uses

By PRILIP H. SMITH

USES FOR BERYLLIUM COPPER Fuse clips Vibrator arms Contact brushes Appliance plug chps Plughourd contacts Switch jaws Circuit breaker spring-Relay springs Brush holder springs Electric range switch parts Thermostatic control springs Leaf or helical springs Contact springs Bourdon pressure springs Optical alloys Spring washers Sylphon bellows Diaphragms Fountain pen clips Camera parts Instrument parts Gasoline and oil-pump parts Cams Valve parts Watch parts Gears Precision bearings and bushings Plastic molds Die casting dies Welding electrodes Non-sparking tools

and sulfur These qualities have been in a number of ways which require dis-CHESION

Beryllium plays its outstanding rôle as an allowing metal, and beryllium copper is out in front at the moment Copper, as we know, is a soft metal, but add anywhere from 1.5 to 2.75 percent of berylhum give it heat treatment, and that of steel The usual admix is about 2 percent When beryllium is added such amount, the resultant alloy shows a tensile strength of 70,000 pounds per square inch in an annealed, soft state, whereas cold-rolled and heat-treated strip will give a tensile strength of 190,-000 pounds per square inch. By way of contrast, structural steel has a tensile strength of 60,000 pounds.

It is the peculiarity of this alloy that

it can be formed in relatively soft temper, and in the ductile state can be rolled, forged, and drawn After heattreatment it acquires its extreme strength and hardness

Beryllium-copper has very wide use as a spring material A more uniform product can be made - because of the above-mentioned heat treatable characteristic - - than is possible with spring steel and phosphor bronze, and the allov is virtually unturne. A beryllium copper spring, for example, can be flexed 15 billion times as contrasted to 400,000 for phosphor bronze. In addition to imparting strength and hardness to the alloy, heat-treatment also in creases the elastic limit, modulus of elasticity, electrical and thermal conductivity, and wear resistance. These added properties can be controlled through proper time and heat regulation Finally, beryllium-copper is nonmagnetic and will not spark when struck

t any wonder that this new alloy Is it any wonder that the manu has cut a wide swath in the manu facture of springs? The number and variety of applications is, today, so broad that reference had best be made to the accompanying table. But, at the same time, it would be an error to believe that simple substitution of berylhum-conner has achieved the desired result. Success has come as a result of keeping in mind the basic properties of the alloy when designing a product, as well as understanding completely the heat-treating process With this backlog of knowledge, manufacturers have been employing beryllium-copper to produce, for example, springs having smaller over-all size for use in re-designed equipment featuring space saving Such change overs continue

The high strength of beryllium copper, coupled with wear resistance, has recommended the alloy for bearings. bushings, and certain types of gears. Its non-sparking quality, coupled with hardness, makes it suitable for special tools to be used in plants where there are explosives or inflammables. If the practical nature of such tools is questioned doubt can be dispelled by demonstrating that a beryllium-copper chisel can be driven through steel. As contrasted to bronze, beryllium-copper has a five times greater wear resistance when used in conjunction with steel, and the alloy has been used quite successfully with unusually high loads where there is small relative motion.

Within the past few years there has been considerable experimentation with beryl hum-copper as a material for cast modes in the plastics industry. Some of this work has been fruitful, and cast beryllium-copper modes are in use today because they approach the ideal still

being sought. The particular ments of the material are three in number, a lowmelting point and good flowing qualities which give, excellent reproduction of detail, high compressive strength upon heat-treating, and a thermal conductivity twice that of steel, which permits a quicker melding evile.

There are many types of bevolume copper but it will be sufficient to mention one more. This is an alloy formed with 0.4 percent beryllium, 2.6 percent cobalt, and the remainder copper. Wire of this alloy has been drawn to a tensile strength of 1.37,000 pounds per square inch, having a conductivity 50 percent

that of copper. It has been used to make electrodes for resistance welding and has proved satisfactory in spotwelding stainless steel, in seam welding wheels, and in electrode parts for projection welding.

THE amazing change wrought in copper by a touch of bervilium created an alloy with immediate practical use, but it remained for beryllium to touch nickel to set off a whole chain of verbal fireworks in Washing ton The allow, beryllium-nickel, has not been made in this country, because the method is unknown and experimenters are unumentarily.

stopped It has been made in Germany and the international patent situation was what brought beryllium into the Washington bearings. Testimon was presented to the effect that beryllium-nickel valve springs functioned in aircraft engines without showing the slightest fatigue and that bushings of the material never failed in German planes. It is known, further, that the alloy, heat-treated from the hard rolled material, acquires a tensile strength of



Above One source of beryllium beryl crystals. Below Master alloy -4 percent beryllium, rest copper





Beryllium-copper tools find use near explosives because they won't spark, will easily cut cold-rolled steel, balasc



260,000 pounds per square mch as contrasted to 60,000 pounds for structural steel, and 90,000 for stamless steel. Here, again, 2 percent of berylhum does the tuck.

This revelation — that there was a material available which would improve the performance of aircraft engines — touched off a screes of questions. Is there an adequate supply of beryllium in this country? Can we make berylliumaickel? Cannot beryllium be employed to make a strong, light alloy of alumium or magnesium? These questions were raised m rapid succession and

their answers will throw more light on this metal extraordinary

THERL is no starcity of beryllium the texists plentifully in beryl and ther inneral ores scattered throughout this country and the rest of the world. Its extraction in the pure state is difficult and expensive, but it can and is used readily in oxide form. Cost of extraction varies in accordance with the inchines of the rose and, at the moment, most beryllium is obtained as a by product of other mining operations. Having found how to use beryllium sould mailbraing copper, a short-circuit.

ing of the process has led to lower costs, but problems arising in production of beryllium-nickel are not the

Beryllum-nickel will be made here under German II cense. One of the revealed difficulties is that alloying cannot be carried on with conventional methods without undue loss from oxidation, and that special equipment is required to do the trick, unless, of course, something bitherto unknown is discovered about the handling of the metals

The union of beryllium and aluminum to make a light, strong alloy, is still more of a hope than a reality, despite

all published reports of success. When beryllium is used in high percentage to contribute its advantages of lightness and rigidity, the resultant product is too brittle in the cold state to be commercially useful. Some investigators claim that aluminum can be age-hard-ened, while others declare that alloys of the duraliumit type alone can be so benefitted, and that small amounts of beryllium added to aluminum are inert or behave in the manner of altern A.



Photographs courtes The Beryllium Corporation

Pouring a master alloy of beryllium and copper

the moment, there is a hint that beryl hum and aluminum can be combined to create an alloy having a high tensile strength and yield point at operating temperatures of 500 to 600 degrees. Fahrenheit. If this hint is substantiated, the aircraft industry may have a new material for optons.

Magnesium, another hope, has not yet gratified experimenters by forming an alloy with beryllium, and the problem is complicated by the difference in melting points. Whether or not some way will be found to make the ultrastrong, light-weight alloys which hope has made "fact," in the news, remains to be seen. The value of such a discovery puts it in the not impossible class of research projects. The mere suggestion that hope is not ahandoned as a way of saying that probers will keep hard at work.

Among research men there is speculation as to what might be done by employing powder metallurgy to combine beryllium and aluminum or magnesium Significant results have been obtained by mixing the powders of other metals and heat-treating to produce hard materials, so why not try it here?

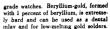
Some of the interesting successes in bervillium research are nickel-chronic iron-beryllium and beryllium-gold. The former alloy has a possible elastic limit of 200,000 pounds per square inch. is highly corroston-resistant and non-magnetic. Its commercial use is now limited to replacing watch spring steel in high-



Typical use of beryllium-copper, for its fatigue resistance, in electrical contacts for time-control clock







While beryllium's affinity for exv gen is a nuisance in the production of certain alloys, this affinity is an asset to industry. The metal reacts with all oxides at high temperatures and seizes upon nitrogen, sulfur, and carbon, as well The deoxidizing and desulfurizing properties are now being used to permit production of high-conductivity copper castings and to remove the sulfur in steel melts. Even when a high sulfur content remains in steel, it is still possuble to roll it if beryllium is present in small amounts. Pure nickel can be rolled without using magnesium and manganese if beryllium is added

T should occasion no surprise of beryllium makes more rapid commercial progress from now on Aluminum, molybdenum, and the rest of the newer metals required a solid groundwork of research before they advanced far into industry Beryllium production processes have been simplified to bring price within a range that warrants research looking to wider commercial application. The achievements of beryl hum copper have been adequate to answer skeptics, and resistance to adoption is now very largely overcome by the knowledge which fabricators have acquired as to its use. The metal is hardly obtainable in the pure state, but there are master alloys available with copper. nickel, and iron

In many respects cost is still a deterrent to use but when it is recalled that other metals began their careers from a high plateau and dropped lower as use expanded, the present course of beryllium as wholly normal. If as many still, hope, alloys with light metals can be produced, cost will be less of an obstacle because performance will be worth the price. Such an achievement would justify all the research work which could be brought to bear upon the problem, and would validate all the flaming headlines which have promised a revolution in metals.





Why Pure Science Pays

Time After Time Scientists Interested in Finding New Facts Purely for Their Own Sake — Intellectual Curiosity — Have Handed Fortènes to Industry

By A. CRESSY MORRISON ,

MICHAEL FARADAY'S discovery netic induction, was, for him, the reward of an excursion into the unknown, the fruit of pure reason, an idea embodied ultimately in an experiment To Faraday's contemporaries, his discovery meant little or nothing. To those of us who live in this electrical age, Faraday's toy has become the foundation of a new civilization. It showed the way to harness the vastly powerful forces of electricity Light heat, power, and all the wonders which flow from the millions of electric dyna mos and motors, which lift burdens of toil from our shoulders, delight and amuse us, employ simply and directly the principles of Faraday's discovery

Whatever may have been Faraday's gift of prophecy, it is certain that he was led to this discovery, as to others, by an insatiable desire to learn and to know No hope of other reward was needed to goad his active imagination. No vision of immediate usefulness spurred him in the search for truth.

Quite obviously, in our fast moving age, the long gap between Faraday's discovery and its application to human needs has been materially shortened by the development of vastly intricate industrial machinery to feed upon and utilize the results of researches in pure science Obviously, too, the wealth created by industry should supply the essential support and stimulus to research in pure science President Conant of Harvard has described this relationship by a happy analogy drawn from the field of biology. He terms the mutual interdependence of pure science, pursued for the purpose of increasing human knowledge and industry, whose objective is the creation of wealth in the broadest sense of that word, as "symbiosis" (living together). To make this meaning clear, he illustrates symbiosis by describing the process by which lichens live A tender green plant synthesizes food for itself and also for a strong colorless fungus whose hardiness protects both from destructive forces The application of the figure to the present subject and its aptness in describing it are evident

Each phase of knowledge is connected to by strains, often mysolibe, to a previous state of knowledge. Hence, we must give considerable credit to astronomy of for things that are now of everyday uster meyer some instances of fundamen taltal ideas essential to further development of science, which have come from more as to have become practically lost

A MATHEMATICAL equation de vised by Clark Mawwell has given us radio and television. The velocity of light was first discovered by Roemer from observations of the eclipses of the pupier's satellites, and the motion of velocity of light or radiation was essential to the formulation of Maxwell's laws. A second instance of a very remote connection in Newton's law of organization and the principles of me channe, which were arrived at on the

has so of the motion of the Moon. It is these principles that are the base of the entire complex of mechanical things that we passess at the present time.

Astronomy made necessary the study of optics It has developed the strength of the human eve until it has become a 200-inch reflector. Optics has, in the other direction, aided in the development of the microscope, until all the beneficent results of microscopic investigation are now in our possession and the end is not yet. The development of the study of ontics and the correction of the imperfections of the human eye has given us the universal use of ordinary eyegla-ses which have become one of the great factors in safety in human enjoyment, and the advancement of education

We are indebted to astronomy for the spectroscope, which discloses with marvelous accuracy the constituents of mixed climents to be found throughout the universe, but few realize that this same instrument is now in practical use in hundreds of industries, and is disclosing immersurably small amounts of impurities which may be useful or harmful in substances heretotore considered as pure. The majority of astronomers, if asked "What is the use of astronomy" would probably quote Pomeare, "Lastronomic est utile parce qu'elle est belle" (astronomic se utile parce qu'elle est



Research in pure science at the General Electric Company, Hardbeaded industrial men have learned that research in pure science often pays fat dividends. Experience abundantly proves that, if research men are permitted to broaden the ecope of their problings, unexpected insights and by-product facts turn up and can be converted into wealth exceeding by far the original research costs

is beautiful). If we study the work of Copernicus and the impact of Galileo's pronouncement that the Earth is not the center of the universe upon the ideology of the world, we find that it has changed and is changing the philosophy of every human being.

Daguerre discoursed photographystep by step it has advanced. As early, as 1869 the process which awaited only the development of the film and

the proper chemicals to produce pictures in color was announced The moving-picture industry rests upon his discovery, and its effect upon the world is already apparent Who would have supposed that Daguerre's discovery, as now developed, would so improve the accuracy and facilities of astronomy that nebulae have now become island universes, space has grown from thousands to millions of light-years, new radiations have been recorded. and photography has become the handmaiden of astronomy

Pderhaps no single scientific discovery has had today witch enormous and so valuable use as catalysis, invaluable use as catalysis, invaluable tool of chemistry. Indeed, there are few processes of chemical industry which do not employ such a promoter of one kind or another to accelerate and direct chemical reactions toward desired ends. Even the simple, universal reaction of combustion requires the presence of a minute amount of water vapor to allow it to proceed.

The ancients visioned the invaluable usefulness of the promoters of chemical reactions which we now designate as catalysts and sought a universally active substance of the kind under the name of the "philosopher's stone" The advent of chemistry as a science directed attention toward these traces of extrañeous substances necessary to bring about certain chemical reactions, and, more than a century ago. Berzelius had accumulat ed enough information on the subject to give phenomena of this type the name catalysis Berzelius and a host of other investigators in the decades that followed pursued these inquiries without expectation of reward, but no intellectual pursuit has had more significant consequences Sulfuric acid, as universally valuable in chemical manufacture as pig iron is in mechanical industry, is produced in our own country by the millions of tons annually by processes utilizing platinum, vanadium oxide, and other materials as catalysts Enormous

tonnages of cottonseed no longer are

wasted to clog streams and foul land-

scapes, since a catalytic process easily

converts their oil content into a palatable, nourishing solid ist. The first World War was begin only after Germany was assured independence of imported in trate for explosive manufacture by the perfection of Haber's catalytic process for making the air supply this military essential. Though a military essential, thow much more important is the fact of an unlimited supply of gitrogen to fer



Apparatus used by Dr. Paul R. Heyl at the National Bureau of Standards, for "weighing the Earth," or determining the constant of gravitation. But why spend public funds for weighing the Earth? One of many practical problems to which this research is related is locating oil with similar apparatus.

tilize our cultivated fields and ultimately save the world from starvation. Our now commonplace, but still amazing, conquest by air of immense distances over continents and seas depends upon catalytically prepared fuels and catalytically prepared fuels and catalytically controlled burning of them in internal combustion engines. What is true of highway traffic in vehicles powered by similar fuels.

A classical case in organic chemistry serves to illustrate the development of a chance discovery by an actively indiving intellect into a fundamental fact of mealculable theoretical and practical importance. This is "substitution" or the replacement in an organic compound, of anotime relement or by a radical (a group of atoms of two or more elements). Substitution was discovered by Dumas, when he was asked to find out why the candles at a ball in Paris gave off suffocating furness when

they were burning Dumas learned that the was had been bleeched with chlolearned with chloman and be found that chlorus had be found that chlorus had be found that chlorus had be severed that project down of the hydroman and the seasural nature. His published paper on what he had found is one of the classics of chemistry, but the does in it was so new that it was seen with peers the season of the published paper. It manifest the published paper is not the season of the published paper. In the page is not published to the published paper. In Lebus *

Annalen, of an ironical paper written by Wohler, but signed "S C H Windler" (swindler)

in spite of the early disbelief and ridicule, the fact of substitution was soon well established and its application has influ enced the greater part of the development of organic chemis try, in the factory as well as in the laboratory Without substitution, the chemist could never have produced the synthetic dyes. or the hundreds of invaluable medicines. It is commonly said that the dyes are obtained from coal tar The truth of this misleading statement is that a few essential compounds obtained from coal tar are the raw ma terials from which are built up, step by step, with the aid of sub stitution, the complicated molecules which meet hundreds of human needs. The enormous development of synthetic organic chemistry is an outgrowth of a simple but fundamental discov

THE photo-electric effect was discovered by Hertz and Hallwachs in 1887 and 1888, re spectively, more or less through difficulties with experiments carried out for other purposes. The photo-electric effect underlies

the sound effects accompanying pictures and is absolutely essential for television

"Marconi was inevitable," according to Abraham Flexner "The credit for what has been done in the field of wire less belongs, as far as such fundamental credit can be definitely assigned to anyone, to Professor Clark Maxwell who in 1865 carried out certain abstruse and remote calculations in the field of magnetism and electricity Maxwell reproduced his abstract equations in a treatise published in 1873 Other discoveries supplemented Maxwell's theoretical work during the next 15 years Finally. in 1887 and 1888, the scientific problem still remaining - that is, the detection and demonstration of the electromagnetic waves which are the carriers of wireless signals - was solved by Heinrich Hertz, a worker in Helmhotz's laboratory in Berlin. Neither Maxwell nor Hertz had any concern about the utility of their work. They had no practical obsective The inventor in the legal sense was of course Marcon, But what did Marconi invent? Merely the last technical detail, the now obsolete receiving device called a 'coherer,' almost universally discarded" Yet no man will deny him the vast credit due him for making pure science in this field of su preme importance to the world

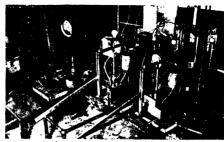
We may smile at the entomologists who measure the proboscises of butter flies and bees, but the practical applica tion of their studies becomes immediately apparent, as is well-known in connection with that very useful plant, red clover It seems that Australia set out to grow clover, imported the seeds, and had successful crops for a year or two and then the crops failed It was then that the entomologists came to the rescue and imported humble bees, the only insect that can fertilize red clover and now clover grows

THE utility of geology as a means to the discovery of metals, minerals. oils, and to the location and physical characteristics of materials for dams and other structures, is so apparent that we cannot walk a paved street anywhere in the world without its geological relationship echoing with every footstep The search for the remains of prehis toric animals has led to discoveries of prime importance in all directions. But civilization, while based on material things, is equally dependent upon the increase of human knowledge The greater our understanding of the structure of the earth and the history of hving creatures through an almost infinite past, with their ultimate relationship to man, the more the mind of every thinking person broadens, and better judgment develops into tolerance and understanding These contributions may do more to the elevation of the mind of man. the real objective of human life, than can be gained from developments which add merely to man's security and com fort

Early attempts to measure the con stant of gravitation, using the torsion balance, provided experience which has made possible one and perhaps the most important form of geophysical prospecting now used to find oil

Dalton's atomic theory and Mendeleeff's periodic law developed the idea that all matter was composed of a limited number of kinds of indivisible build ing bricks, known to us as the atoms of the elements, out of which all things are constructed. While these concepts were indispensable as stepping stones to a better understanding of the structure of matter, they seemed to close the door to the possibility of anything outside of the material

The discovery of radium smashed these bricks and transformed them into little constellations, with a central nucleus about which revolved electrons at



Apparatus for placing matter under pressures of half a million pounds per square inch. This is research in pure science; the experimenters were not aiming at any particular financial gain but were activated by intellectual curiosity at almost containly industry will find applications for the new knowledge gained

minimesimal but relatively great, distances from the nucleus. This opened the door to a better understanding of forces, probably enormously more important to the ultimate dusting of manthan the material benefits which have already so magnificently followed the discovery of radio activity in all its present applications

Few know that the study of the local motion of fishes has added to the speed of airplanes

Gibbs' phase-tule, as is well known obtained in Gfbbs' profound studies of the guiding idea that has made possible a great part of our development of allovs and certainly had much to do with modern metallurgy. The real greatness of Josiah Willard Gibbs is slowly but surely becoming realized and as an American scientist he now takes his place as one of the first mathematical physicists of all time

The Joule-Thompson effect deals with the change of temperature when a gas expands from a high pressure to a lower one. It is the basis of the process of hauefaction of gases, and of the air conditioning and refrigeration indutries we have at present I doubt whether any reader of the original scien tific papers describing this discovery could have had any idea of the tremen dous potentialities of the simple "porouplug" experiments as originally carried out

In 1917, belium was a chemical curi osity that had been produced only in small quantities by investigators in pure science Its discovery on Earth had fol lowed the finding of it in the Sun-Where it could be bought at all, it cost about \$2000 per cubic foot. However technical men saw the possibility of extracting belium from natural gas for use in lighter than air craft and suggested it

for mulitary aeronautics. An efficient extraction process was developed, by which helium could be secured in quan tity at low cost Helium is now produced at approximately one cent per cubic foot, and in quantities suitable for man's цвев

IN addition to the use of helium as a non explosive lifting gas for airships, st is valuable for deep-see diving and for medical purposes. Mixtures of helium and oxygen prevent caisson disease Within the past year, new diving records chemical and physical equilibrium, is so have been made using belium. The medical profession now prescribes helium mixed with 20 percent oxygen as a breathing atmosphere for persons af flicted with asthma, and this gives almost immediate relief. This humanitarian use of a once rare gas offers wide possibilities of medical application, according to reports by doctors who are studying the effects of helium on respiratory diseases

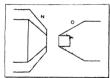
On the fine work of separating helium from natural gas rests our greatest chemical industry. By the use of waste gases from petroleum and natural gases. the use of coal and lime and ultimately, oil shale, we now or will produce an unnumbered variety of valuable chemicals plastics textiles like silk and wool. and possibly food and drink

These examples, drawn from many fields of purely scientific inquiry, show in unmistakable terms the enormous value of giving the searching imagination free reign. Even the calculations of astronomers, accustomed to huge figures could not evaluate the wealth of comfort, convenience, health, and happiness that stem from the researches I have mentioned. To forecast their effects on future generations is beyond human powers, great as these have been shown to be in other directions

Soundless Sound Waves

A PALM tree crashing to the ground of an uninhabited atoll makes not even the shightest break in the utter silence. This statement is correct, of course, only in the sense that no ear perceived the fall. So far as the adia, or enter arm molecules were concerned, however, sound waves were generated because the creah set them into long.

tudinal sibration
Yet even the presence of an auditor does not always insure that a sound will be heard. This follows from the fact the eardrum of the average human being responds only to sound whrations ranging from a floor of about 20 to a ceiling of perhaps 20,000 c vides per second What goes on in this 20 to 2000 range



Redrawn from The Jour Scientific Instruments
Figure 1 The simple principle of
the Hartmann ultrasonic generator

is, needless to say, of daily stid concern to everyone. Indeed, its omniptes ence seems, on occasion, to be almost too much with us. What transpires in the basement below 20 and, more expecially, in the upper stories above 20 000 is more mostriavise but it constitutes one of the more interesting displays in the Carnesis Shon of the Sixed chemistry.

The region of the subaudible, that is of sound waves with frequencies below 20 cycles is of but little practical im portance. The amusing story is told how by their use R W Wood, Research Professor of Physics at the Johns Hopkins University once -- and only once -- panicked a theater audience. The author of the play planned a blackout punctuated by a shrill, drawn-out scream, to represent the turning back of 145 years. In rehearsal, however the transition proved none too convincing. Wood therefore lugged a 40-foot organ pipe backstage and, timed with the scream, poured a flood of powerful but maudible sound waves over the darkened orchestra. An eerie chill of unreasoning fear swept over the audience and when the blackout faded 145 years earlier the lights revealed that the audience had precipiThe Odd Realm of Supersonics-Inaudible, Versatile Vibrations-is Receiving Increasing Attention From Scientists Paradoxical Behavior

By WALTER L. FINLAY, Ch.L.

tously declined to make the transition and were safe in the 20th Century, out side the theater Later, a shaken spectator observed that he had experienced much the same sensation just before the San Francisco carthouse.

Above the audible range is the region of the ultrasonics cultra-beyond, son ics-sound) These soundless sound waves have recently become the focus for a flattering share of scientific atten tion 1 The spothight is well merited. The investigator is lured on not only by the potential importance of ultrasonics -both theoretically and practically-but also by their paradoxical behavior. The latter is particularly intriguing, for ultrasonic vibration is, among other things A producer of dispersions of solids in liquids but a destroyer of dispersions of solids in gases, in liquids, a disperser of solids but a coagulator of gases, in electrolysis, a promoter of desirable but a suppressor of undesirable gas evolution, with pathogenic bacteria. in some cases an augmentor and in others a diminisher of virulence, and, when applied to a human limb, a heater of the marrow but a non-heater of the

THESE are versatile vibrations indeed Frequencies from 20,000 up to 500 000,000 cycles per second have been experimented with. In the higher ranges these vibrations take place so rapidly that the remark has been made that these vibrations are "all acceleration and no motion".

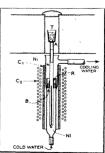
No very efficient producer of ultrasome vibrations has as yet been developed. At present the three most popular ultrasonic generators are the Hartmann air jet the piezoelectric oscillator, and the magnetostrictive vibrator.

The Hartmann generator (Figure 1) unctions by directing a et of air with a velocity higher than that of sound from a nozzle, N, into a special cup-shaped receiver. O The frequency of the ultrasonics produced is a function of the "Over 200 single publication in the last decade and the regent publication in the last decade and the regent publication of a facilities ("University N & Wood, 139).

dimensions. Professor Hartmann reports the relatively high efficiency of 4 percent for his device.

Piezo means 'to press" A piezoelec tric crystal is one which when pressed, develops a voltage between the faces pressed. Since the value of the voltage is proportional to the pressure, the piezoelectric crystal affords a very neat and accurate means for the measurement of pressures. What is even more interesting and more to the point of this discussion is the fact that the piezoelectric effect is reversible, that is if an alternating voltage is applied to the faces of a properly cut piezoclectric crystal, the crystal will alternately expand and contract in phase with the applied voltage, thereby producing sound waves

The most commonly used prezenter tre crystal is quarter but there are many others. The feature which all these crystals have me common is the fact that they lack a center of symmetry. At the expease of some oversimplification one can one consider an ionic crystal to be made up of an array (three dimensional network) of positive ions, interpretizing an array of the original properties of the common of the commence of the comm



After Schmidt and Ehret in Zeit für Elektroche Figure 2: Apparatus for making ultrasonic waves magnetostrictively

crystal the ionic charges cancel out completely throughout the crystal. Hence the crystal as a whole as neutral. But of a crystal, which is not symmetrical about its center, is compressed, the spatially its center, is compressed, the spatially its content of the control of th

Equally useful and interesting is the magnetostruction effect—the thrid method. If a rod of fevromagnetic material is placed in a magnetic field parallel to
its length, the latter is changed slightly—perhaps one part in a million—and a reversal of the field will reverse this change. Lake the piezoelectric effect, this phenomenon is reversible. Compressing a nickel rod, for example will increase its magnetization. And, if a coil is placed around the rod the compression will induce an E-MF in the coil

AN experimental magnetostrictive oscillator devised by Schmid and Ehret is shown in Figure 2. A water cooled nickel rod, Nr. about 10 inches long, is used as the vibration generation. It is magnetized by the direct current or 10 C, and excited into magnetostrictive vibration by a high-frequency current in the water-cooled, experstuding coil C. The Bakehte collar, B, supports the rubber ring R. A crueible, T, is brazed to the nickel rod at 4. Schmid and Ehret were investigating the effect of ultra sources on meeting and the collar, by the collar particular example, is surrounded by a furnace.

When this crucible was filled with water and ultrasonically vibrated, the water was transformed into a very fine mist in less than one minute. Any liquid of low viscosity is similarly atomized Professor Boys has pointed out an inter esting analogy to this in the explosion of a depth charge. The first intimation to the observer at the surface that the charge has exploded is the sudden de velopment of a fine spray some 10 to 15 feet high Directly thereafter the familiar geyser, propelled by the explosion gases, lifts its tons of water gracefully from the sea and obliterates the mist This mist is never noted after the explosion of a mine because the relatively large volume of air in the latter acts as a cushion between the impact of the exploding gases and the water

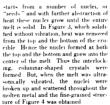
Several interesting results were obtained when metallic melts were subjected to ultrasonic vibration in the mag netostructive oscillator. Figures 3 and 4for example, illustrate the grain refinement which can be obtained. The metal employed happened to be cadmum. When a metal freezes, solidification





Figure 5 An unvibrated specimen

The top pair of photomicrographs displays the contrast between the grain sizes obtained without and with ultrasonic vibration during the solidification of otherwise identical meli-The refuned group structure of fore considerably enhanced me chanical properties. The next pair contrast a similar effect on an alloy with a brittle gruin boundary The latter is completely broken up. That at right shows a dispersion of lead in aluminum, with ultrasonic vibration maintained during freez ing the dispersion is maintained



By a similar mechanism, segregation is counteracted, and brittle grain boundaries can also be broken up. Thus Figure 6 illustrates the effect of ultrasonics on the continuous grain boundary material of the unvibrated specimen in Figure 5.

Lead and aluminum are no more miscible in the liquid state than are oil and

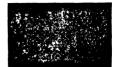


Figure 4 Fine grain Vibrated
All photomicrographs coursesy Dr. G.
Schmid and Zell für Ricktrochem
eft Figure 3 Coarse, unvibrated



France 6 Same specimen vibrated

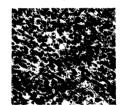


Figure 7 A vibrated dispersion

water and their difference in densities is much greater. Nevertheless, even here the industrous ultrasonies can bring about a fair degree of emulsification. Figure 5 shows a dispersion of lead in aluminum. This dispersion is not very stable but if the ultrasonic radiation is continued until freezing is complete the dispersion is of course, maintained

The potential commercial applications of ultrasones are interesting. A whole new indistry, popularly known pawder metallurg, has come into being in the past few years to full certain definite needs which conventional metal-lurgical methods could not satisfy, for example, to make "forced allows" for bearings of metals which are immiscible in the luquid and solid states. Perhaps the emulsifying power of ultrasonic vibrations offers an alternative process for effecting certain metal combinations otherwise unobtainable.

(To be concluded)

Restoring Rome's Colosseum

FOW the lions, tigers, and other savage beasts were handled and liberated simultaneously into the arena of the great Roman Colosseum with a dispatch that would do credit to Frank Buck, Clyde Beatty, or any other famous animal director, has been re vealed by the excevations of Prof. Gin. seppe Cozzo, an Italian authority on that historical structure. For centuries. until recently, the lower half of the Colosseum has been bursed and none of its lower parts has been visible

After several months of excavations into the long-hidden depths of the Colosseum, Professor Cozzo has uncovered the hypogeum or "back" stage, 20 feet below the level of the arena, where the stage was set for gladiatorial combats with wild beasts, also where the stage settings and the cages for the beasts

were kept

The ancient hypogeum contained not only the cages of the wild beasts but 32 cells for lifting them simultaneously to the level of the arena. The animals whipped by the keepers who followed them, were forced to pass from their cages to and along a passageway less than three feet in width to the elevator cells. In this narrow space they were unable to turn around to attack. The cages in which beasts were lifted are indicated by the discovered evidence to have been 38 inches wide, five and a half feet Recent Excavations Beneath the Ancient Arena Reveal Elevator Shafts for Raising Wild Beasts to the Combat Level by Means of Counterweights

By H. T. RUTLEDGE

long, and almost six feet in height. This was large enough. to permit holding the largest lions in these cages for several hours at a time, in order to have them ready when they were wanted in the arena. The cages themselves no longer exist but their di mensions have been approximated from the size of the elevator shafts. Similar cages probably will be constructed The elevators were operated with counterbalancing weights - not alone by winches and pulleys as most authorities on the Colosseum had previously supposed. At a signal by the stage manager, the 32 keepers released the respective counterweights and the 32 cages rose simul taneously. The cages had no doors but, until they were lifted, they were shut off by



Workmen with dump cars of earth and debris to be removed from beneath the arena

Partly ruined tiers that once supported the seats in the Colosseum Seating capacity was about 50,000, though this is often exaggerated - was done so, in fact, by the Romans themselves



iron gates immediately in front of them As soon as the wild beasts reached the level of the arena, about 20 feet above, and found a free outlet they made their way, attracted by the light, through separated corridors and all appeared in the open at the same time.

As the arena was an oval 281 feet in length and 177 feet in width, the combat sometimes lasted a long time, since the battle probably was not immediately provoked, as it would have been in a small space. Indeed, the arena was so large that the contest with the beasts was called venatio - a hunt - and the men who hunted were called bestiari.

Eighteen hundred years ago a band of gladiators in the arena held their spears at an angle against the sand floor as they nervously awaited the entrance of the lions. At a preconcerted signal, the famished hons appeared from the sides of the arena, stalked the gladiators, and the battle with the beasts followed Thrilled by this terrible spectacle which came to cap a program of cruelty, more than 50,000 spectators, often including the Emperor and always many of the nobility of Rome, looked down from the several tiers of the great Col-

Although there were many amphiheaters in Roman terratory, including the one as graphically described in Bulver Lytton's "Last Deyot Department" none of the others had the Campent, none of the others had the campent of access as were held in the great Colesseum at Rome In the hundred days of games held upon the opening of the Colesseum, 5000 lims, tugers, and other wild heasts and 3000 gladiators were slaughters.

As the Colosseum was unique in many respects it is important to reconstruct the giant edifice as near like the original as possible. However, restoration will not involve completely rebuilding the structure as it originally stood, but will mean the reconstruction of all those parts that remain. Thus the floor of the arena will be reconstructed, not of pine boards as it was in the Romans' day, but of substantial concrete — though a part of the flooring may be of boards, in order to give the public an exact idea.



blow the central part of the Colosseum appears today after the current excavations, showing the complex structural details beneath the arena, which was carried on bridging planks



Laborers trundling a dump (ar along a light track 20-odd feet below the level of the ancient arena. Through these same passageways howled the lions of old Rome

of the maneuvers employed in setting the stage for gladiatorial combats or for great pageants and sporting events. It has also been suggested that sports be revived in this famous amphitheater

Now that the plan for reconstruction is under way, it will be of interest to recall some of the more outstanding facts about the Colosseum. Even today it is a gigantic and impressive structure and not at all lacking in majesty because of its modern surroundings. It was begun by the Emperor Vesapasan. who brought with him on his return from Judea 12000 Jewish prioners to do

the rough labor It is 159 feet in height. We made and in plan is elliptical with the major or axis 615 feet, the minor axis 615 feet, the minor axis 510 feet of the major of the plan is composed of huge blocks of travertine rock, though the interior is of the marble and brink It is still possible to the composed of the plan is t

The arena was surrounded by a walf 12 feet high to protect the onlookers from*maddened beasts or men. This wall now is largely ruined The basement part which Professor Cozzo has been excavating is made of long, thin bricks (Roman bricks)

In the Colosseum the seats nearest the arena were reserved for the state officials, and about free were free those for the nobles and the rich. Higher still were those for the populace. Exis (somitoral) were efficiently designed to faciliste departure of the crowds, the Romans were just as aware of such matters as we are today, and perhaps a lattle more so than some of our earlier designers of large auditoria. The Colosseum seats were numbered and the "tuckets"—
inscribed clay pieces—have been found.

inscribed clay pieces—have been found. The first Christian marryrs to be thrown to the wild beauts died in the urena of the Colosseum and, because of these martvrs, who succeeded the gladators, the Colosseum was wenerated greatly during the Middle Ages. It was considered to be a monument conscipted to the martyrdom of the early Christians. Only for that reason was it saved and for the same reason the vast structure, partially in runs but still impressive in character, is still reverted by many in the civilized worth.

POR bindrees of years, through which degeneracy and sevenulty and ill-won opulence helped bring about the corruption of once great Rome, the brital combats persisted in the Colosseum Only when Telemachus, a whate-clad monk, on January first, 404 Ap., placed himself among the blood-stained gladgators and called a balt in the name of God to the shedding of Blood, did the gladingied combate cease. Telemachus was affected to death, but Honorarius, the Consett, issued an edict forbidding such combats.

GLASS TAKES ON COLOR

NO longer is a mirror merely some thing to use for shaving or to check the tilt of m'lady's milhinery. The hand of research has litted us out of the old/dashioned Looking Glassera Colored plate glass, for example, has stimulated new thought, opened the door to a mental gold mine of interpretice thinking in applying new types of flat glass to serve us better in utilizarian and decorative uses in every-day

One of the interesting trends among architects designers and interior decorators now becoming increasingly popular is the practice of facing an entire wall area with plate-glass mirrors. Thus, in rooms of restricted size, is given a sense of spaceou-ness by apparently doubling the size of the room and repeat ing furniture and fixture patterns by reflection. This idea received added impetus when plate glass became more and more available in larger uzes, and it was accelerated particularly with the recent advent of colored plate glass.

New Fields Opened for Plate Glass . . . Decorative Mirrors . . . Sand-Blasted Designs . . . Panels Lighted at Edges . . . Careful Experimentation

By EARL AIKEN

The most extensive use of modern flat glass of any installation that has yet been made in this country is in a Chi cago restaurant. One whole wall was faced in colorful opaque structural flat glass, with colored inlay worked into a series of scenes depicting the harvest ing of food products throughout the world, sand-blasted designs in clear plate, the panels edge lighted by indirect illumination to make the characters seem to float in space, and a whole wall in mirrors against which was built a stairway and semi-circular ceiling light ing fixtures. The restaurant seems double its actual size and the vast reflecting areas repeat design and colors m such a way that the surroundings strike a new high in practical fairylandia

From the business man's standpoint this movement is thought-providing. The Chicago restaurant just mentioned is not an exclusive rendezione but a cafeteria where office workers are in the majority. Since modernization, the restaurant's business has tripled

This new interpretation of what can be done with plate glass in the form of mirrors has lifted many pressure of mirrors has lifted many pressure of utilitation beauty. But the small gown shop, the little coketal lounge, the drug store, and all the stores along down shop, the new source on the modern Magic with Mirrors, the modern from from the colonial Cape modern from the colonial Cape in the drug with Mirrors, the modern from the colonial Cape in the first plate of the fact that you can see far more than yourself if you'll look at a nurror property.

SCIENTIFIC development of a prodoften is visualized by the lawman as a drably mysterious evolution among test tubes, bi-focal delving into volumes of chemistry data by scholarly gentle men who talk in riddles and move in a atmosphere of pre-occupied self-sufficiency. Quite the contrary, of course, modern seventic developments sparkle with interest. Consider, for example, the development of plate glass. Its historic past and romantic present are rivaled only by its fascinating future

In order to get a better appreciation of it, however, it is necessary to understand, first of all, the difference between plate glass and sheet or window glass Most people, when asked for the answer, usually say "Well, plate glass is thicker," and add an explanatory note that it's "heaver" and 'larger !

That sn't the answer, of course In chemical content and physical size, window glass and plate glass may be identical: the difference between them is that plate glass must have further processing to produce the characteristics which make it superior. When window glass leaves the lehr or annealing oven, it is a finished at ticle, requiring only wash-



Rustrations courtesy Libbey-Owens-Ford Mirrorred plate-glass paneling, placed at one end of a living room, reflects the dining room beyond, making the living room seem larger than it is in actuality

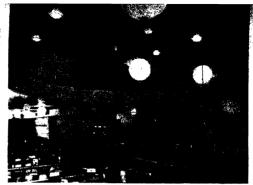
ing, outting, and inspection before being boxed for ahipment. But when a plate glass "blank" leaves the lehr it is still a semi-finished raw material requiring for completion even more work than has already gone into it. Its surfaces must be ground and published to relatively close standards before it becomes plating the property of the property of

On broad convoors water than flat cars and, like flat cars, moving on rais and in trains, the blanks, continuously bathed in water and sand which varies from coarse to fine, are carried under totating grinders where the corrugated surfaces are ground away to parallel planes, thus eliminating distortion lo taking off waves and surface irregularities. Then the conveyors carry the glasonward without interruption under the polshing machines, where, with fine iron ovide—rouge—as an abrasive, the glass is polished to high luster by feli-

faced disks rotating at high speed. The surface, therefore, rather than content or thickness distinguishes plate aglass from swindow glass. The granding and polishing of plate glass give su perior clarity, gleaming feature, and uniformity of surface long recognized as a valiable factor in the manufacture of mirrors in the display of goods in show windows and slow cases.

THOSE applications, however, have been broadened into a vast field of amazing scope during the past five years, but to evaluate this development more completely it is helpful to look back briefly into the history of plate glass, an absorbing chapter in America's industrial history.

Although glass is one of man's oldest known materials, the invention of plate glass occurred in France in the 17th Century The idea was conceived by Abraham Thevart and Lucas de Nehou. who contrived to pour glass while in fusion upon a table and to flatten it with a roller. Their goal was to produce larger and thicker sheets than was possible with the hand-blowing methods of that time Apparently they had not conceived plate glass as a highly polished glass of great clarity as we know it today, their interest seemed to be con fined to getting larger and thicker panes (Window glass at this time was first hand-blown into cylinders of restricted size, then cut on one side and reheated so the cylinder would slowly flatten out Large panes of window glass as produced today were impossible to make.) The first plate-glass plant began opera tions near Paris in 1668, and was soon duplicated in other countries, but the industry did not attain any commercial importance until the 19th Century



It is done with mirrors. The mezzanine rail is built against the mirrored wall, adding a tot of spaciousness and luxury to the surroundings that would be difficult to obtain in any other y

For 100 years after Nehou and Thevart poured their first crude plate glasthe product languished, its market being mainly for small mirrors. High prodution costs, difficulties of transportation and the many imperfections in the glassitself precluded. Its use during this period as a window glazing material.

In the 19th Century, improvements in formaces and the substitution of coal, and later of gas, for wood as a fuel gradually stimulated manufacturing improvements until France and Belgium were making a vasily improved plate glass vel very inferior in quality and volume production compared to the present

It is interesting to digress here momentarily before logically byting the American development of plate glass. The first attempt to make plate glass in America was in 1860, at 1-nex, Massachusetts but for many years it was such an inferior product that practically all of the plate glass used in this country was imported.

A representative of European glass interests boasted of this fact Apparently unaware of rapid developments in the United States, he finally became the target for a Philadelphia glass johler Secretty marking three lights of plate glass the Quaker City merchant asked the agent to select the best of the three plates, explaining that at least one was of European manufacture. Much to the representative's chagrin he selected a plate glass that had just arrived from a glass plant in Missouri.

Into the American glass picture, right after the Civil War, there strode a man who came to be known as the father of the plate-glass mustry in this country the was Captain John B Ford, son of Johnsthan Ford, pioneer Kentuckian who had left Danville in 1814 to join the

kentucks troops who journeved down the Olion and Mississippi to meet the British in the Iclium gdays of the War of 1812. John Ford, the son, had been born a vera before and grew up to become a successful iron manufacturer and Mississippi Bliver fleet operator before turning his evers to the possibilities of plate glass. Eight vears after the first American attempt to make plate glass had failed in America Captain Ford became interested and, in 1870, began operation of this country's first commercially successful plate-glass plant—in New Albany, Indiana

THERE followed 10 years of rapid cyanasson climaxed by a financial collapse. Captain Ford had but several plate glass factories, but a combation of crumstances dound him, in 1880, a man nearly 70 years old and the fruits of his long years old and the fruits of his long years old abor completely swept away. What he did to overcome this situation at his age, when most men have retured, is not only an eppe of American hardthood, but an integral part of this country's plate-glass better.

He had lost ever-thing but an anasing energy and capacity for work. He boarded a train for New York City, hopeful of recouping some of his financial loses for a new start by selling a patent on sewer pipe made of rough glass to Peter Cooper That famous inventor and philanthropist was 20 years the senior of Capitain Ford, but the two veterans saw eve-to-eve and the Captain sold his patent for a worthwhile sum

On the train or route to see Mr. Cooper in New York Captain Ford, due to his habit of striking up conversation with strangers who seemed interesting to him, had met General John C. Fremont He persuaded the famous soldier



Overhead lighting fixtures at the left are semi-circular, the mirrored wall gives full-circle illusion. Structural flat glass, with sand-blasted designs, used at right

to permit him to attempt to sell some lands held in the west by General Fremont. He made the sale and the commission he received from that, coupled with the sale of his patent to Peter Cooper, enabled Captain Ford to interest eastern capital in starting a plate-glass plant in Pennsylvania. This led to additional plants until all were merged into one large organization, and printsburgh.

TWO sons, grown to mature business men, had joined Captain Ford about the time he built the Creighton plant and one of them. Edward, became the president of the Pittsburgh company. Edward Ford eventually resigned, and m 1989, purchased a 173-acre farm site adjoining the city limits of Toledo, Ohio, and built what later became America's largest plate-glass factory under one roof

Edward Ford, son of the "father of plate glass in America" (who passed on in 1903 at the age of 91) died in 1920 and exactly 14 years later the men who carried on helped to introduce a prod uct-colored plate glass—that instantly made plate glass available in new field-

Plate glass was first made about 275 years ago. Up through the years, scent tific improvements in quality were the major goals as processes and equipment were improved, and its use by architects and designers increased accordingly, but there came a time when they said, in effect. "We can't use clear plate in any other way. Give us more color."

Colored glass had been made in Europe for many years, but, due to lack of demand in this country, little had been manufactured here

Sand is a principal ingredient in all glass, but for plate glass it must be of the finest quality to insure clarity Ottawa. Illinois, where much of the pol ished plate glass used for laminated safety glass is produced, is the hub for some of the best silica sand deposits in this country Known as St Peters sand it received its name from surface de posits near St Paul, along the present Minnesota River, formerly known as the St Peter River The deposits extend east and west, and from Minnesota wouthward into Arkanaga In many places the deposits are 1000 feet under ground, ranging upward in shallowness to surface exposures Among the more Moportant surface areas are those at Ottawa and Dixon, Illinois, 80 miles northwest of Ottawa, and in Calhoun County, Illinois, along the Mississippi

Like sand is very white, exceptionally making a low iron uniform in quality and has a low iron uniform. In quality and has a low iron content—between 01 and 02 percent it is hines and sparkles almost like glass itself. Most 01 us timk of "fine white sand" as that found at Atlantic City and along Florida and California beaches, but, compared with St. Peters sand, they would produce a glass of poor color.

Another fine grade of silica and adjusted along the western foothills of the Appalachuan range from southern New York state into West Virginia. In 1934, the Toledo glass scientists introduced a variety of shades of blue "plate glass. Three types of blue were selected—balt, medium, and dark—and vision was possible through each. Color control? Well the glass me inked@hat problem and the public reaction to the blues was so favorable that green plate.

was added, and then peach color. Was all this a great scientific problem? Well, it could be made to appear so, but it was more a matter of careful and tedious experimentation. And there were some laughs, too

Take, for example, the time when some of the research group at the plant founded by Edward Ford were nosing around for the best ways to make golden plate glass. introduced commercially this year.

One day a truckload of sugar arrived at the main entrance gates to the plant. The driver wanted to know just which of the many buildings beyond the fence was to get it.

Title gateman, not having been masteries, assumed that such an item as as usgar must have been ordered by the manager of the lineth room operated on the grounds for the convenience of the holicon border workers. Some minutes later the lunch room manager, a rather quick tempered chap, investigated the racket empered chap, investigated the racket expense of the para unfolding the sugar.

"What's that stuff?" he demanded "Eight hundred pounds of sugar,"

"Eight hundred pounds of sugar,"
came the laconic reply.

"Eight hundred pounds," sorted the commissary manager "Why nou big blankety zam zowie. I only have five sugar bowls I couldn't use that much sugar in five years Get t'hell outta here with that"

After some unraveling, it was discovered that one of the research men had ordered the sugar. He had known that sugar, being a pure form of carbon, had often been utilized by bottle manufacturers to get an amber color.

After experimenting with 800 pounds of sugar to arrive at a golden color for plate glass, however, he had to discard the idea of using carbon in this form, masmuch as the resultant glass had "bubbles" in it.

The terrific heat required to melt glass for proper handling makes it im possible to use some color ingredients ordinarily practical for other materials Any one of several faults in glass quality can develop. No dyes can be used, of course, pigments are utilized exclusively and thus plate glass has only mineral coloring.

It would require considerable listing to record all the coloring agents that were trued and rejected, but some of the naiverals that get results include cobalt, chromium, nickel, copper, sulfur, antimony, selenium, uranium, titanium, manganese, and cadmium

All in all, Mr Webster's definition for glass seems inadequate. Class is practically human. At least veteran glassmen declare that during its manufacture glass has as many moods as some women ... that you can never really be sure what it will do next

An 'Engineered' Lily Pad.

** NATURE was the engineer," said Joseph Pavion when describing great design, the famed Crystal Palace in London To prove this, he exhibited a leaf of Victoria regia, the great water-lily of South America, and explained that "Nature has provided the leaf with longitudinal and transverse graders and supports that 1, borrowing from it, have adopted 16 this building."

From an engineering viewpoint, the coormous leaf, or pad, of this hly is so interesting that we quote below some of the details from a lournal of the New York Botanical Garden article by H. W. Rickett.

One who saws for the first time a leaf of Victoria regia floating on the water is likely to ask himself "Would it hold me up." It is said that the Indians. when they gathered the edible seeds "water maize") of the water-lily, placed their children for safe keeping on the leaves (known to them as the "waterplatters") It is only necessary to place a board on the leaf to distribute the weight evenly over the surface. Indeed, if this precaution is taken, a large leaf will support a man weighing 150 pounds One investigator reported pouring sand on to a leaf to the amount of 400 pounds before it sank. Considering the strength and buoyancy which this represents, it is the more remarkable that the texture of the leaf is very delicate. It is easily punctured by a small object failing from a small distance. This delicate blade floats as gently as a film of oil on the water, yet resists the depredations of animals and the impacts of waves and wind, and can support weights of sev-



A group of the gigantic lily leaveat the New York Botanical Garden

eral fundred pounds, providing only that the load is distributed evenly over the surface

The clue to this curious combination of qualities is seen on the lower surface. Here we find the structure to which Paxton referred in the words quoted above. The delicate flat blade is spread over a system of large ribs. Paxton's "garders," which radiate from the point where the stalk is attached The ribs are arrow but deep, the free

edge is somewhat broadened, but the web which connects this with the blade is quite thin. The main ribs of a comparatively small leaf are more than two inches high at the center of the leaf, and their thickened margins are less than an inch wide Half way to the circumference they are one meh high and the edges only 1/4 of an inch wide. These ribs are supported in a vertical position by cross-ribs, which run parallel to the circumference of the leaf and thrust against the sides of the main ribs, many of them are an inch high These, in turn, are supported by sloping narrow buttresses firmly anchored in the leaf-blade. and holding the cross-ribs unright

This is the structure, a product of nature in a remote wilderness, which inspired the design for a great exhibition building in a civilized country on the other side of the world. Ever since Paxton's day, the construction of greenburses has involved similar principles.

Structural design does not cease with the gross arrangement of parts, but ex-

To have its picture taken, one of the great leaves was turned over, as shown at right, so that its structure could be examined. Below is shown a close up of the "longitudinal and transverse garders and supports" on the underside of the leaf. These ribs give the leaf as he strength that it will easily support several hundred bounds everal hundred bounds.





tends to minute internal details, the microscope is necessary to the understanding even of this enormous leaf. The ribs which appear so solid and massive are really structures of great delicacy. They are composed of air-filled tubes lying side by side, separated by thin membranes from their lateral neighbors and interrupted longuidially by perforated partitions, the bulk of the great rib is actually mostly air.

Each tube is a structual unit which resists bending far better than would the same amount of material disposed in a solid strand. Therefore each rib, which is a bundle of such tubes, possesses great strength combined with lightness.

strength commined with lightness.

The air-filled passages are of value to
the water-hly not only for the strength
which they afford to the leaf but be
cause they provide a means by which
gases can circulate throughout the plant.

Mystery Of The Magnetic Mine

BY this time, British naval authorithe mystery of the so called mag netic mine. Our own Navy is doubtless cognizant of its general mechanical characteristics Whether or not its secret has been solved does not alter the fact that nations readily concede it to be one of the most formidable and diabolic instruments thus far to make its debut in modern warfare It is practically im mune from attack. It renders the convoy system a true hazard instead of a meanof safety. It attacks the vulnerable bottoms of even the heaviest of armed battle cruisers. Its presence cannot be effectively detected by any known device. The Burney or parayane method of mine sweeping is helpless against it. Several mines might strike the same target, insuring immediate sinking with heavy loss of life. It is light enough to be car ried by planes

It is easy to conceive the possibility of bottling up naives with mines of this type. Sinkings that are quick and certain are the specialty of this improved weapon; and unless effective ways and means are developed to combat its men ace, the greatest naives in the world are at the mercy of the unseen undetectable, and unattackable

The mystery mines are of two types First, the inert shallow-water type, and, second, the mobile, deep-water type.

The mystery mine is comparatively light in weight since it requires no cables or anchors, this fact makes sowing by aircraft a practical possibility Contrary to speculation, the present mine requires no parachute but may be dropped into the sea from a height of 200 feet, without damaging its mechanism or without detonation. The detonator does not become 'alive" until the mine has been submerged and surrounding water pressure actuates a spring loaded hydrostatic trigger which sets the detonation circuit by piercing the seal on a small tube of mercury This mercury fills a cavity containing the contact points of the detonation cir cust

One plane may carry a dozen mag metic mines and drop them as if the low over the ocean shipping lanes of an enemy country. If the eargic scomposed of deep-water mines, it will drop them from a height of from 100 to 200 feet of directly into the sea and they will mine to 400 feet. What happens then may be to 400 feet. What happens then may not the mine's mechanism as shown in the accommanying drawing.

By C. E. MILBURY

The mine has three distinct compartments within a casing of non-magnetic metal. The upper one contains a batterv. a magnetic device or grid, of the compass-needle type, several electrical circuits, and two hydrostatic diaphragms that work on opposite principles. The middle section contains the explosive with its detonation caps. The lower section contains an air flask that gives the mine its accelerated rising power after displacing its ballast water. Vent valves near the top of this compartment are held open by light springs, pistons close these valves when compressed air reaches them through small copper pipes connected with the air flask. At the bottom of the mine there is an opening through which sea water will enter when the more strikes the water, the air being expelled through the open vents The extreme upper compartment is connected to the lower or air compartment by a tube, the lower extremity of which is firmly screwed into the neck of the an flask, with its spring trigger-valve and its firse seal

THE mine's bottom is weighted for and sinks tail first. The mine descends rapidly toward the bottom and, at a depth of 70 feet, a diaphragm in the side of the mine near the top, set to operate at an external pressure of 35 pounds. moves inward. As it does so, it pushes a tiny piston which forces the seal from a small metal tube of mercury. The mercury makes a connection between two electrical contacts. This same operation also operates the solenoid and releases the brake on the magnet grid Thus the mobile and detonation circuits are set, but not completely so, for an other hydrostatic valve, pushed inward by water pressure, keeps open the final detenation circuit

The mine finally reaches bottom and sea floor ooze closes around it A approaches, and, at a distance of half a mile, causes the magnet grid to wave slightly. As the ship approaches nearer, the grid slowly deflects upward, finally pointing to an angle of 50 degrees Things begin to happen. At this single of deflection, the magnet grid makes a light electrical contact which, in turn, operates the fuse seal that restrains a spring-loaded valve of the air flask. The fives melts, permitting the air valve to open, the blast of air thus released rapid displaces the water ballast from the

lower compartment through the hole at the bottom of mine, the sir vents having been closed by action of their pistons. The force of the water-and air jet at the mine's bottom breaks the mud suction and the mine rises rapidly due to increased buyovancy and the jet's push

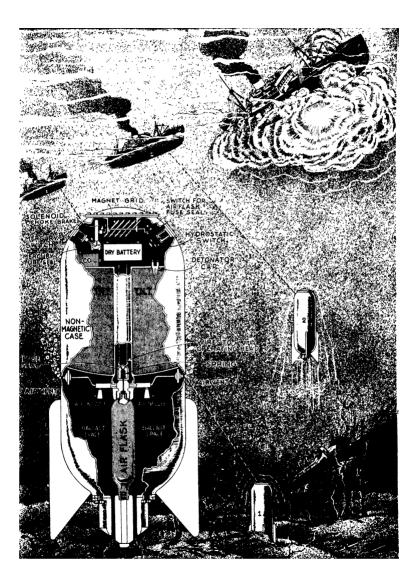
Detonation occurs automatically when the nume reaches a level of 50 feet below the surfact. This is caused by the outward bulging of the six outh hydroxides with which has been held in the open position by hydroxidia pressure. What that pressure is sufficiently released (at the 50-foot level), the witch closes the detonation circuit, and the explosion

The possible elaborations that may be made in the way of further refining this mine are without possible limit and are to be gaged only by the cost of construction. The mine as now used posturely does not follow a vessel by magnetic, at traction, nor does not destroy by impact, its destructive action heigh like that of a depth bomb.

The mert mine, which is laid in chain nels and harbor entrances is similar to the mobile mine, without the compressed air system and hydrostatic defonator is Being lighter, it may be more easily handled by plane. The mert mine creates all of its have without leaving its mid or sand bed, but the magnet in this case is adjusted to defonate at a deflection of 90 degrees. This insurase its detonation only when a vessel in about to uses directly over it.

There will arise an important prob lem after neace has been signed as to how the menace of these mines will be removed They cannot safely be swept by wire dragging, for the dragging vessels would be destroyed Even wooden vessels have some machinery that is magnetic and would therefore actuate the mines Sailing vessels might be used with some effect, but perhaps the safest, most effective method would be to drop barrages of small depth bombs from airplanes The best solution would be to construct such mines so that the grid would be disintegrated by electrolysis after a reasonable time

At right The ingenious, mobile, magnetic mine (German) powered by compressed air. The fish's-eye view shows approaching ship (1) affecting magnetic grid so the mine starts rising; at (2), mine rises vertically as ship approaches; and our artist's conception of the explosion near the ship





Conducted by F. D. McHUGH

SCREEN MADE BY ELECTROPLATING

NEW and unique development made possible by newly perfected electro forming methods is the production of metal screens, reports the magazine Inco The fabric is built up as a one-piece metal product wholly by electro-deposition, no



Screen being stripped from cylinder

woven or other foundation structure is in cluded in the deposit

The product is designed to serve purposes lying between those now covered by perforated metals on one hand and woven wire screen on the other It combines accu racy of hole diameters with the amouth surface characteristic of perforated metals Its percentage of openings lies between 16 percent and 50 percent of the total area, depending on design These figures are com parable with those obtainable in woven wire mesh Generally, the electroplated screen is used in the fine meshes below the limits of perforated metal Essentially, it supple ments rather than competes with conven tional woven wire

The plated screen, known by its trade name of Lektromesh, presents a smooth surface and is readily fabricated by draw ing, stamping, welding, soldering, and the like It is stiff, tough, and strong Another Contributing Editor ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

special feature is the latitude in design which it makes possible. The mesh can be of any shape and of a variety of sizes. It has a unique quality in the fact that in some sizes and designs a two inch piece may be stretched to one foot. It also can be designed to avoid heat conduction. Since it is an integral structure, it will not un ravel

Continuous production methods are used with such success that screen has been made in rolls 36 inches wide and up to 1400 feet in length.

In manufacture, the desired design is gransferred by a succession of sensitizing, etching, filling, and surface treating proc esses to a metal plate or matrix. These operations leave the metal surface of the matrix in a condition to receive the electro deposit uniformly where desired and yet allow it to be withheld where open spaces are necessary The matrix, when completed



Strip of electro-formed strainers

with its exposed and masked sections, is fastened to a circular cylinder which revolves in the plating bath. As the cylinder revolves, the metal deposits are built up evenly and uniformly on the exposed are of the matrix

Thickness of the deposit depends on the current density used and upon the speed at which the cylinder turns. The deposit in the form of a continuous sheet of screen s stripped off the matrix automatically.

Commercially, Lektromesh has been pro duced in sizes from 25 to 400 mesh, with the bulk of production to date lying be tween 25 and 150 mesh. "Wire sizes" have ranged from what in round woven wire would be 0008 to .025 of an inch in diameter

The complete processes of production are covered by patents held by E O Norris, Inc. under which the (, t) Jelliff Company holds exclusive rights

THE ESKIMO GOES MODERN

DENTISTRY has taken firm root among

A Mackenzie Delta Eskimo had a tooth knocked out by a harpoon handle. He had heard of the white man's false teeth and, after pondering the matter for a while, he carved a tooth from mory, root and all and drove it into his jawbone with a mal-

According to Philip H. Godsell, who tells the story in an article in Natural History, the magazine of the American Museum of Natural History, the man was apparently none the worse for his painful but effective bit of dentistry

MOUNTING TIRES WITH AIR PRESSURE

THE need for injurious pounding of tire beads in mounting tires on automo bile wheels has been effectively eliminated by the Safe-Way Pneumatic Tire Mounting Tool, a product of SafeWay Tool Company



Air mounts a tire

This lightweight aluminum tool uses air pressure to mount tires noiselessly and

The tre is hung on the wheel in the issual manner, then the Safe-Way tool is hung on the rim, in contact with the lower exposed bead An air hose is connected to the tool, and, in the short space of three seconds, the tire is in place on the wheel No pounding of the bead, no missing the tree with the hammer and damaging the wheel paint. A noiseless mounting job is done in a tiffy.

To keep the weight of the Safe-Way tool down to a point, where one man can handle tri, alumnium alloy castings are used for most of the parts. The entire tool weights only 18 pounds, and exerts a pressure of one ton when working on an air pressure of 125 pounds.

PAVEMENT ROUGHNESS

IN constructing highways it is necessary to climinate waves and humps which would affect motor-car speed and comfort. Hence, after a pavement is laid, these humps are hunted out and rubbird down Many types of devices have been worked out for the hunting job but until development of the Vagraph there was no satisfactory recording mechanism.

The Vagraph, which was recently dissured in Goldrona Highways and Public Forks, produces a graphical representation of the road surface. The present instrument is a further development of a surface, meter first made by Mr. Claran F. Galloway "Essentially, the road surface meter is the same as the original Galloway instrument," sava Mr. Douglas II Greeley, writing in the above-mentioned magazine. "Some improvement in design and construction was effected and a totalizer to record the travel of the graph pen has been added in addition, an odometer was also added so that engineers' stations or distance might be observed."

As shown in the accompanying illustrations, the where of the instrument make a three point, in-line contact with the road as surface. When this shows to operated at a walking speed, it is steered by turning the handle in a manner similar to that of the throttle control on a motorcycle. The recording mechanism is operated by the middle wheel which is mounted in a "beat" of the middle wheel which is mounted in a "beat" of the middle wheel which is mounted in a "beat" of lowered on the graph paper as the instrument is wheeled over, an irregular surface.

"During operation," says Mr Greeley, "the chart paper progresses at the rate of one inch sach 20 feet, the pen movement being sit a ratio of two to one, that is, a bump one quarter inch in height will be drawn one half inch in height on the chart As this process continues, the pen's movements, in a positive direction only, are measured by the totalizer and recorded by an over rading clutch which allows the negative movement of the pen to occur without measurement. Also during this process, and the distriction of the pen to occur without measurement. Also during this process, and the distriction is recorded on the odometer the odometer than the contract of the pen to occur without measurement.

ONE-EYED SPECTACLES

THE cycglass of the future — a million years or so hence — will look like the model designed by Pitt II Horbert, of the Bausch & Lomb Optical Company, if look opens are covered in the support of the property of the pitter of t

often does 90 percent of the seeing.

The effect of a dominant eye is to decrease stereoscopic vision. Things look flatter. Some biologosts, looking thousands of years into the future, suggest that in time



For the future?

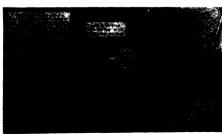
all our seeing may be done with one eye and that, in effecting the change, Nature will have moved the eye to the center of the face, perhaps in the middle of the fore head, turning us into a race of Cyclopes

FRUIT FLAVORS.

There are so many fruit flavors used in cases, pies, ices, and soda-fountain drinks that it is usually taken for granted that these are natural fruit flavors. How-



General view of pavement roughness recorder and abelous close-up of chart



ever, there are but few pure fruit flavors now on the market and most of these are not satisfactory. The processes of manufacture now nue permit undessrable changes to occur. These changes after the flavoring and make it less desurable than the synthesis of the satisfactor of th

In announcing that a study of the preparation and manufacture of pure fruit flavors ration and manufacture of pure fruit flavors from strawberries, raspherries, and cherries has been undertaken at the New York State Experiment Station, that station announced that it might even be necessary to blend new flavors of fruits which will yield especially potent flavors that can be easily extracted. This new project has been set un under the terms of an industrial



Artist's drawing of a 'gyro patrol plane landing on a platform built on a freis

suspected germs in the blood given, Dr. Novak points out. Blood for transfusion is always tested for syphilitic infection before use. Tests for other germs which may lurk in the blood of healthy donors are not always made Germs can also get into the blood when it is drawn from the donor or in preparing it for storage, in spite of precautions that are always taken against such contamination - Science Service

ROTORCHART PATROLS FOR MERCHANT SHIPPING

XTENSIVE studies of the possibility of protecting merchant shipping by the use of autogyro patrols has been made by R. (. Kellett of the Kellett Autogyro Corporation. The results of these studies were made public at the recently held Second Annual Rotary Wing Aircraft Meeting in Phila

Modern autogyros, with jump-off charac teristics, can operate on platforms no

fellowship sponsored by one of the large food corporations, Fletcher Chase, a chemical engineer, is now engaged on this project. Should success attend his efforts. new and larger markets for flavors much be found than that now commanded by the synthetic flavors trade, estimated to be in the neighborhood of one million dollars a

NEW RUBBER-METAL

ADDESIVE

THE sharp demand for bonding agents that enable manufacturers to wed rubber to metal and Thiokol "synthetic rubber to iron, steel, lead, and the like, is producing real results. Latest result is Tv-Ply a non tacky adhesive marketed by the R T Vanderbilt Company This adhesive is of two types Tv ply "R" for rubber and Ty-Ply "S" for Thickel

Using this adhesive, manufacturers can brush or spray practically every metal with a thin film. Within a very few minutes, this Ty Ply film dries sufficiently to receive the layer or sheet of rubber or Thickel to which it is to be bonded. The assembled product is then placed in molds and inserted in a vulcanizer Upon completion of a short vulcanizing cycle, the mold is emp tied to reveal an exceptionally strong with unit Besides being non-tacky, the new ad hesive is economical to use because the thinnest film gives the best bonding results with metal

The development of such adhesives, researchers contend, is hastening the day when it will be practical to protect tank cars, vats, and other metal equipment with linings of oil proof, grease-proof "synthetic rubber '

BATTLE FOR "KEROSINE"

W EBSTER still insists that it be spelled W "kerosene," but for 15 years the American Petroleum Institute, the American Society for Testing Materials, and a few hardy publications and individual converts have weathered mild and sometimes bitter abuse by joining in an orthographic adventure to promote the spelling which they believe is correct "kerosine." Proponents of "ine," slowly growing in

numbers, point out that gasoline, benzine,



and kerosine all are coined words having no strict chemical meaning. The "ene ending, as in toluene, benzene, and other words, indicates a definite chemical com pound. Since the ending of kerosine should have no chemical significance, they say, it is much to be preferred that the ending cor respond with those other coined, non hemical words, than that it have an ending hich might possibly be confused with the demical "ene" words Gasoline began its life with both endings, but finally set tled down to the more logical spelling. For ome unexplained reason, however, the

ene' became firmly attached to kerosine. Even if Webster and other official arbiters of orthography do adopt "ine," however, the present proponents feel certain that for decades the mails will continue to carry a steady flood of letters beginning, "I liked your article, but why don't you spell that word right?

GERM-FREE

"BLOOD BANKS"

SULFANILAMIDE, powerful chemical remedy for a host of germ diseases, is now being used to make blood transfusions A small amount of sulfanilamide added to blood that is to be stored in blood banks for future transfusions prevents the with of bacteria in the blood for from 10 to 15 days and may even make the blood completely germ-free. Details of the method were recently reported by Dr Milan Novak, of the University of Minnesota.

Some of the serious reactions occurring after blood transfusions may be due to ungreater than 40 by 60 feet, which can be installed on most sea going craft. One of our photographs shows an artist's conception of such a platform. Tests with con-ventional aircraft indicate that visibility can be obtained to a considerable denth below the surface of the sea A 'gyro patrol could therefore readily locate mines or submarines, and its pilot destroy them with depth charges or bombs. Under such a plan, surface vessels would carry patrols of two or three 'gyros, so that there would be constant protection even when one or more of the aircraft were being serviced or refueled. (See also page 339, December, 1939, Scientific American - Editor.) An alternative proposal, shown in another il lustration, would be to use a converted tanker or freighter as an autogyro carrier

The suggestion is timely and deserves full consideration by the navies and merchant marines of a number of countries.-A K.

LESSONS IN MILITARY AIRPLANE DESIGN

HAT is the best possible way of learning the requirements of the military design of aircraft, short of taking part in acrial warfare? Answer To study every hit of news that comes through the omsor's hands Is the speed of the Messerschmitt useless in comparison with the greater maneuverability of the Curtiss Hawk? Then too high a speed, and too high a wing loading (militating against mapeuversibility), must be avoided. Is the new Messerschmitt, equipped wish two 1900horsepower engines, and carrying a really long range cannon more than a match for the Spatifies? Hen we must grow attention to twin-enguned pursuits, similarly equipped with cannon Can bombers, with adequate machinegun fire, reach their objectives and fight off a swarm of enemy fighters? If not, the long-range bombers must be supported by snafes seaters having a similarly long range. Needless to say, combatants in the present struggle are artist in such studies. If the British and French missions craft orders, then it is because they are studying reports of this character before carding one polye and types—4 Kor

ANCHORING SMALL AIRSHIPS AT SEA

FROM Commander J. L. Kenworthy, for the Lakehurst Naval Air Station, we have received a first-hand account of the excellent methods which have been developed by the Navy for anchoring small airships or "blimps" at sea

There are two main problems in anchoring the blimp, one is to achieve static equilibrium, the other to hold the ship at rest against the action of the wind with engines not running, or merely idling

At the end of a journey, the airship has consumed a certain amount of fuel, and is therefore light. To release helium from the gas bag is too expensive. In a large rigid airship, the exhaust gaess are cooled, the vapor condensed by cooling adds ballist to the ship and restores equilibrium. But a water recovery process is too bulky and clumey for use on a small airship.

So the problem of making the ship heavy at the end of a ovyage has here solved in a novel and ingenious manner. Suspended from the front of the airship or at hy two vertical cubbes, there is a large, coincid shaped water ballast hag. The lower up of the bag is connected with the rar end of the car by a hard in open of soundle of the car by a hard in open of soundle garded as conformal, the coincid has can be filled with a deserted quantity of



Rubber boat approaching a blimp moored at sea

water, and then drawn above the surface of the water. At the same time, ballast is dropped from the ariship to about 50 percent of the weight in the conical water bag. The buovancy of the gas bag itself now holds the slip in tant equilibrium.

Thus the first problem is solved in a simple yet effective manner. The second problem was solved by an improvement in the use of a drogue or drag anchor. The drogue consists of a flat initial cone which is payed on the a way from the front of the ship. The nose moorrang-point seems to be best suffered for the drogue wire. The drogue is connected to the payonit wire by a four-legeld bridle, and is kept in the proper position, free from the influence of surface waves, by a weight below and a rubber float on top. By adjusting the leggs of the bridle, the pull can be adjusted in

direction and to some extent in magnitude With this drogue, the ship can be kept at anchor, it can also be steered and the airship can be maintained at rest at various angles to the wind direction.

The story does not red here, however. The top opening of the water ballists big is cheed by a heavy were melon of which is called the above the method of the control of the story of the control of the story of the control of the c

Television Broadcast of an Aircraft

ENGINE

ONN of our photocraphs shows Roadd S. Gall, of the Wright Aeronautoal Corporation, bushly demonstrating for the first televison broadcast of the operation of an aircraft engine. The Wright 1100 bursepower, nunceyinder Cyclene was cut away and revolved by an electric motor. BRC actually staged the show under the Such television broadcasting, has real possibilities of an electromagnetic production of the superior of the stage of the such as the superior of th

100 Horsepower, 100 Pounds, \$100

WE do not always agree with William B Stotin, noted aeronautical engineer and designer, in his conceptions, and he does not always bring his brilliant conceptions to commercial fruition, but no man as more word and stimulating magnation in technological matters. Writing in Aero Digest, he gives us a slogan which is fascinating. "An engine of 100 horsepower; weighing 100 pounds; at a cost of \$100."



Demonstrating, by television, the operation of an aircraft engine



... a capacity of 157,750 gallons per minute

This is a splendid goal to shoot at, we are badly in need of inexpensive and light engines of 100 horsepower for private flying High revolutions per minute, in a six-sylinder opposed, flat or paneake type of motor, which, if desired, can be hidden inside a wing, is Mr. Stout's solution -A K.

CANDLE-POWER

SOMEONE has estimated that a half ton of candles would be required to produce the amount of light used monthly by the average family. The cost would be about \$350 as compared with the electric light bill of that average family, which is about \$2.50.

SLUSH MOLDING PHENOLIC RESINS

WHITE metal and other materials have poured into a mold and agutated until a shell of the material cools in all parts of the mold and a hollow casting results This process has now been adapted in the plastice field so that hollow castings of plastics may be obtained

With metal, slush molding as relatively ample because the netal chila and hardens quickly on the inner surface of the mold, The problem with plastic was more difficult, for a hardening accelerator had first to be discovered. This has now been found and a large variety of hollow plastic castings can be made, including advertising diaplays, lamps, souvent novelties, and a number of other products

Latex rubber is sprayed on the model to the reproduced, and allowed to cure to the proper consistency. Then a fairly heavy coat of plaster of Paris is spread over the entire outer surface of the rubber. This plaster-and-rubber mold is cut away from the model, fitted with dowel pins, and as-embled as a rubber-lined plaster slush mold ready for production.

Liquid resin, properly accelerated, is then poured into the orifice of the mold and against by revolving or slushing the mold for a period of 15 to 20 minutes. The accelerator cures the resin to the necessary hardness in this time, after which the mold is disassembled. The resolutant casting faithful reproduced detail, and has a sectional measurement of $\frac{1}{16}$ to $\frac{1}{16}$ to $\frac{1}{16}$ to $\frac{1}{16}$ to $\frac{1}{16}$ to $\frac{1}{16}$ to minute of the produce of the casting is could to be light, tough, and translucent. The natural twoty color of the mass be complemented by the addition of such lacquers or spray paints as will emphase its best characteristics.

If properly handled, the mold can be used for about 150 castings.

GUN FIRES WIRE ON PARACHUTE

MUCH has been written of the balloon which are intended to entangle enemy bombers. In our December issue we described a further entangling device consisting of small free balloons supporting a wire at the end of which was attacked a bomb. Both of these defenses should prove very effective.

The United Press reports a third entangling device which consists of a steel ribbon hundreds of feet long which is supported

by a parachute after being fired in a shell from a big gan. This is an American invention but is now being experimented with says the United Press, in France. The trick of the invention is said to lie in the method of colling the wire within the shell. That shell is described as being about 6-inch caliber, and is fired from guins in regular fashion. When it reaches its highest altitude, the nose falls away, uncolling the wire as it falls and dragging out the purachute which them supports it for a slow descent

It is easy to see that a barrage of shells of this type would quickly form a veritable network of wires dangling in the air, unseen by enemy bombers. Any one of those wires, caught in a propeller or on some part of the plane itself, would bring it down

A MATCH FOR EIGHTY FIRE ENGINES

EIGHTY of the largest fire department pumpers, working at full speed, could barely produce a torrent of water equal to the stream the strange looking device in our illustration lifts into the main powerhouse at the Rouge Plant of the Ford Motor Company in Dearborn, Michigan It is the impeller of a vertical lift pump which has a capacity of 157,750 gallons of water per nunute compared with a maximum capacity of 2000 gallons per minute in a fire department pumper Every 24 hours four of these huge pumps bring as much water to the steam condensers in the power house as is used in the same length of time by a great The water comes from a 1' tunnel which connects the plant with the Detroit River, two miles away The impeller was photographed recently while undergoing a minor repair in the Ford tool and die shop. It is six feet in diameter and more than 20 feet long

D. C. LOCOMOTIVES

Title accompanying illustration shows the first of the four most powerful D C boromotives in the world, built by General Electric for Paulista Rullways of Brazil, being loaded on the S S Santos in Brooklyn glore alignment to Santos, Brazil For high-speed passenger service, this locomotive and have at open parted of 50 miles per hour. They have a continuous rating of approximately 4200 horsepower, and a one-hour



Loading a powerful D. C. locomotive for shipment to South America

rating of 4560 horsepower—a rating higher than any other direct-current locomotive now in use either in this country or abroad. They are powered by 3000-yolt motors.

The Paulista locomotives have a gage of five feet, six inches, and in order to test them, the Erie G-E Works was required to lay a special wide-gage track Paulista Railways has a large number of electric locomotives in service.

RESEARCH

DURING 1939, approximately 2000 individual companies apent some \$215,000,000 for industrial research. Two leading companies in this work for progress were du Pont with a research budget of \$7,000,000 and Dow Chemical Company with one of \$14,000,000.

MILKWEED ENZYME MAKES STEAK TENDER

THE lowly milkweed can be made to yield a rare derivative that aids diges tion and makes tough steaks tender, it has been revealed

Asslepain, the new derivative, is a proteolytic enzyme, which breaks down the protein in foods into more ample, easily digestible substances, it was reported. Only one other plant has been found to yield a similar substance—the papaya, source of papain—Alcohol News

MACHINE TO CURE

M NOWING that it has long been established that copper is an excilent fungcide, researchers A C. Conrad of Yale Lunversity and Dr Howard W Haggard worked out in the laboratory some mouths ago a process for what amounts to an impregnation of the skin of the feet and hands with the competence of the state of the competence of the compet



To destroy athlete's foot fungus

MONUMENT

to an Engineer's Hobby

by Westinghouse



Just a few weeks back a small crowd gathered on a hilltop in the Alleghenies to pay their respects to the station that had pioneered all radio broadcasting. The station they were honoring was KDKA; the occasion, the dedication of a new 50,000 watt transmitter located at Allison Park, near Pittsburgh.

 Present at this ceremony were many people who nineteen years before had heard and participated in the first official broadcast ever made—the announcement of the Harding-Cox election returns on November 2, 1920. Since that historic day radio broadcasting has developed so rapidly, extended its sphere of influence so far, that not many are aware of its humble beginning.

• It all started in the garage of a young Westinghouse engineer. He was such a stickler for accuracy that he couldn't even tolerate a few seconds variation in his vestpocket watch. To satisfy this whim, he rigged himself up a crude radio receiving set of the type that was

then known as a "cat's whisker", so he could pick up the time signals sent out at regular intervals by the Naval Radio Station at Arlington.

- Out of this hobby came a prodding urge to make radio something more than a signalling device for the benefit of ships at sea. With the help of others, this young engineer eventually established station KDKA and immediately a new voice was heard in the land.
- For the first time a church service was broadcast over the air, fents throadcast of a presidential inauguration was heard; radio anouncements of baseball scores, time signals and market reports became a daily feature of this new public service.
- When we remember the flaming speed of radio broadcast development since 1920, it is amazing to find the pages of history attributing so much pioneering to a single station. And so the installation of this new equipment is consistent with Westingbouse's desire from the very beginning to extend radio's usefulness and improve the quality of both programs and reception.
- All this means a great deal to you who are within the sound of KDKA'S new voice. That takes in about everybody, for in addition to the standard KDKA broadcasts, short wave programs from the same studios over station WPIT (formerly W8XK) are heard around the world.
- In addition to KDKA, the familiar call letters of Westinghouse stations WBZ, KYW, WOWO and WGL are further indication of our close association and interest in this important and exciting industry.

Experimenters - Schools - Field Workers

An Accurate Balance at a Price Wifnighthe Reach of All



Sensitive to 2/50 gram
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Treating fungus infection of hand

under the skin from a solution, and was discussed in the June, 1939, issue of Scientific American

This process has now been reduced to practice in a machine made by Mine Safety Apphances Company and called the M 5 A Rheoderm, which treats fungus infections of the hands and feet by the iontophoresis of copper. This machine is a relatively simple electrical apparatus that can be op erated by any doctor, and is absolutely safe. It introduces metallic copper into the deeper layers of the skin without injury to the skin or discomfort to the patient. The majority of patients so far treated with the instrument have experienced prompt and gratifying relief from all symptoms of athlete's foot, indicating that the method possesses efficacy that will be widely welcomed

NAVAL GUN CONTROLS

AFTER the recent battle between the AFTER the recent battle between the the coast of Uruguay, so many newspapers commented on the fact that guns had to be hand-pointed after certain controls had been smashed that some readers have asked us for details concerning the manner in which guns are operated on naval ves-

There are two methods of controlling the fire of the guns of a capital ship. One of these is called "director" fire, the other "pointer" fire.

The normal method of control in a mod-Thus is essentially a "follow-the-pointer" system Here the gun pointer, the man who lays the gun in elevation, and the trainer, the man who lave it in azimuth. both do their job by matching pointers. One of these is actuated by an electrical transmission gear, the other is mechanically geared to the gun-elevating or gun-training mechanism The electrical impulses for elevation emanate from the plotting room, down deep in the ship, where ranges and spotting data are analyzed, and sent out over this repeating system to the various gun mounts. The impulses for training come from the particular "target bearing transmitter" that has control at the time. This latter is merely a master sight, generally in a position of great elevation, that is kept constantly trained on the target manually. The actual firms is done from the control tower or whatever unit has control. The work of the gun crew is mainly to load and unload the guns. Of course, each gun or untert has its own swatch, and the guns can not be fired until these switches are through a substitute of the control of the con

The impulses for training, in the "three or for fire method, do not flow directly from the "target bearing transmitte" to the gun mount. They are fed not range clocks—more often called range texpers—in the plotting room. The whole fire control problem is analyzed on these range-keeping machines, and the impulses for both elementon and train are sent from the range-keepin control and train are sent from the range-keepin come from the range-finders, and the spotting data (or rections) on those by the objects who does the aporting. The latter is available, of ourse, only once the battery has opened once.

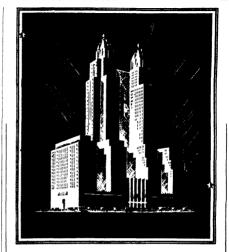
"Pointer" fire is essentially individual operation of the guns. This would be necessary were the control tower shot away. or the fire control system generally put The plotting room out of commission sends out its ranges and deflections over electrically operated visual signal evidence The authoriter acts his sights to these values, the effect of this being to displace the axis of the gun from the telescopic sights by amounts calculated to take care of the range and deflection. The pointer puts the horizontal cross wire of the telescopic sight on the target, the trainer puts the vertical wire on It is the pointer who fires when the firing signal is given - or as soon thereafter as he is "on" the target Should the plotting room cease to function, the officer in charge of the battery, or the gun captain, would call out the ranges and deflections as best he could, and continue the fire on his own control

In addition to these, it may be stated that some experiments have been made with what is, called "kmote control" direction of the gans. Her the control carends as taully to laying the gans in elevation and in train by power mechanisms, eliminating only the follow-the pointer" personnel and leavant in go only the loading and unboating of the battery for the gan crews. This has not generally been applied to large turret mounts, being used more for the lighter anti-arrenting used.

ALUMINUM TINNING

THE difficulty attending the job of solidering aluminum has become traditional of great significance, therefore, is a new tinning flux for aluminum, which makes possible simple soldering with commercial solders Called Amo, this flux is a product of the American Solder and Flux Company.

To tin aluminum, using Amoo, it is necessary that the metal be properly cleaned and preferably roughened. On thin sheet metal, either a clean source of heat or an extra hot soldering iron may be used. On cast aluminum or aluminum alloys, the heat is supplied around the surface or from the opposite side. When the flux is applied to the surface and heated, the section is at



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first the same as with ordinary flux, but as the heat is continued, a heavy white vapor is given off. With this action, the deoxidiing and tinning of the metal takes place, after which ordinary tin-and-lead solder may be used

MEDICENE

THE dried and powdered bodies of five poisonous creatures are still used as medicines in China. According to Natural History magazine, these creatures, often depicted in jade carvings, are the lizard, the snake, the toad, the spider, and the centurede.

SWEDISH INSTRUMENT

FOR LOCATING CABLES

A NEW instrument, which makes it possible to locate accurately and rapidly underground cables and piping, has been constructed by a Swedish firm, the L M Ericsson Telephone Company, of Stockholm

The device consists of three separate parts a transmitter buzzer, a cable finder with built in frame aerial, and a finder coil The measurement is based on the principle that an electro magnety, field produced by an alternating current in a metallic conductor can affect a telephone receiver cir-The alternating current is produced by the transmitter buzzer, which is connected to one end of the cuble or pipe to be investigated, and also to the earth carrying the cable finder in the direction of the cable, the exact position of the latter is easily determined through the intensity of the sound in the ear phones, which is strongest right above the cable.

In this way can also be fixed the exact place of an earth leakage, since the electromagnetic field, and therefore also the sound, disappear at such a place. It sometimes happens that an earth leakage has arisen without it being possible to discover any visible injury to the cable armor after excavation. It is then that the third part of the instrument, the finder coil, is em ployed With its aid, the precise point of the fault is fixed Experiments also have shown that in cases where several cables were lying together, the one connected to the transmitter buzzer could be found without difficulty through the coil. Another feature is that a low-tension power cable without a fault does not need to be put out of service if its route is investigated by

means of the new method.

The cable finder also can be used with
success in locating gas and water mains. —
Holger Lundbergh.

OIL FROM UNDER THE OCEAN

M ORE and more oil is being taken from whell offlied under the cocan some distance from shore. Large numbers of wells have been drilled on the California coast from the extreme ends of purea streeting out into the water. However, in Galveston Bay this under-water drilling needs no connection with the shore, mainly because of the shallowness of the water. According to the Sizendard Old Bulletin,



Discovery well in Galveston Buy

seismographic surveys were made on the floor of Galveston Bay covering an area of 236,000 acres Later, a detailed survey was made of 48,000 acres of the original 236,000. Both jobs were done by crews living in a houseboat and working from special barges and boats. This work resulted in the discovery of a buried dome and the first wildcat well drilled on this dome became a discovery well at a depth of 6030 feet. Two more wells were drilled - these being drilled from pile foundations as was the first. It was then found ad-visable to change the method of drilling. and so a barge was put into use By this method a large barge, to provide a drilling platform, is filled with water and sink over the location for a well. Drilling is done from a rotary table which stands up above the surface of the Bay Throughout the work area, the water is not more than 12 feet deen, and when one well is completed, it takes only from 12 to 18 hours

to lift the barge and move to a new location There are now 11 wells completed and two are in process of drilling. The discovery well is about one mile from shore and the others vary in distance from three quarters of a mile to two miles.

NEW PREIMONIA

TREATMENT ANNOUNCED

NEW chemical treatment for pneu-A NEW chemical treatment for pneu-monia, using a new drug, sulfathiazole, as been announced to the medical world. Physicians who tested it experimentally on human patients, reports Science Service, pronounce it even better than sulfapyridine, widely hailed in recent months as the chemical conqueror of pneumonia.

The new drug is safer than sulfapyridine, and it does not make the patients sick. Nausea and vomiting, which have been a distressing feature of sulfapyridine treat-ment, are practically absent when sulfathlesole is given, physicians report.

Laboratory experiments on hundreds of mice show that the toxicity of sulfathiazole

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is much less than the toxicity of sulfapyridine, except in doses far larger than are needed to cure pneumonia.

needed to cure preumonia. In the body, suilayardine is rather rapuly combined or conjugated with acetic acid. This unfortunately makes the drug neet and useless in its effect on the infection, only the uncombined from being active. The new drug, suilathinagle, howsmaller, which acid is a suilathinagle, howsmaller, extremely a suilathinagle, to the smaller control of the drug, smaller control of the drug, and in the suilathinagle is suilaparidine to treat a pneumona patient. Cfrome possonous effects from accumulation of the drug in the body are much less and to occur because sulfathinagle is excreted more rapridy than sulfathinagle is excreted more rapdity than sulfathinagle is excreted more rap-

FILTERS

"PLACK OUTS" in warring fountries usually necessitate painting factors windows, so that electric lights are necessary in the daxtime. In Ingland, complete obliteration of windows is obviated by use of blue windows and orange lights made. During the day some daylights is transmitted, but at night the blue glass will not transmit towardly the inner orange light.

"Invisible" GLASS

A METHOD of coating camera lenses with evaporated metallic fluorides, which greatly increases the effective speed of lenses, produce a marked improvement in contrast under adverse halping conditions of the contrast of the

is the model of the model of a lighty conwhich further than the model of a lighty conwhich further than the model of a lighty concion is an all surfaces of which a financial film had been deposited. The effective speed of this lens was increased nearly 100 percent. The extent of the improvement by coating, he reported, depends on the complexity of the lens. The increase in speed obtained by coating a three-dement 1/35. lens was much less than for the 1/2 fivecience in the contract of the model of the contended of the model of the model of the model of the contract of the model of the model of the model of the contract of the model of the model of the model of the contract of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the model of the model of the model of the contract of the model of the mo

The method is an outgrowth of Dr. Carriwghi's earlier work with the help of Dr. A Franci Turner, which resulted in reducing reflection and adding to the transmission of light through glass. It is well known that faster and more highly corrected camera lenses require a large number of separate clements. Each separate element reflects about 10 percent of the modeln light Thus, good camera lenses ordinarily have transmissions of only about 60 percent.

Denna: Taylor observed in 1892 that tarnishing of camera lenses tends to increase their effective speed The tarnished surfaces of the glass elements of high refractive index diminished the reflection of light from the sir-glass surfaces and thereby increased the transmission of the whole camera lens. Various methods were devased for artificially tarnishing glass, but

apparently the results were not sufficiently effective to justify their adoption by the manufacturers of camera lenses. It is now evident that the tarnish is actually a film of a transparent material having a lower index of refraction than that of the glass and to be most effective should fulfill specific conditions which can be better satisfied by the evaporated films of the metallic fluorides.

The evaporated metallic fluoride film, Dr Cartwright said, has proved effective for many optical instruments. Since the film must be deposited in a vacuum and since each of the many elements in a camera lens should be so treated, the method is much more easily applicable in the manufacture of new lenses than in the treatment of ones already in use

IN CASE OF ACCIDENT

IN motor accidents alone, one spine is fractured every hour of the 24, according to H Earle Conwell, M.D., a Birming ham, Alabama, physician, writing on "The Automobile and the Fractured Spine" in the Journal of the American Medical Associa tion. The most common type is the compression fracture, and, "without a doubt, Dr Conwell says, "certain lives ended in



Wrong . . . and right

the past by motor accidents could have been saved and permanent disabilities presented by proper first aid "

Witnesses wishing to be helpful after an accident sometimes rush up excitedly, hoist the injured into the air as in the upper photograph of the pair on this page, and carry him away The correct way to transport a person in whom an injured spine is suspected or possible, and when no stretcher is available, is shown in the lower photograph The reason is explained by Dr Conwell.

In riding, the torso of a passenger is usually braced somewhat at the lower end by the legs When the accident comes, the chest and head are thrown forward. This often causes a jackknifing at some part of the spine and the effect is often to crush or partly crush the front side of one or more vertabrae. Obviously, the carrying position shown in the upper photograph further forces the crushed vertabrae together, but the second position, the correct carrying position, has the opposite effect.

Many fractures of the spine are not recognized, Dr. Conwell states, because the patient is able to walk after the accident.

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The patient often under-estimates his in-jury, frequently stating that he has a "kink" in his back and that the disability is of no importance. Frequently there is no deformity of the back, though there is always a backache of varying severity Regardless of the insignificance of the injury, he urges, one should feel suspicious of a spinal fracture when pain in the back is present

Dr. Conwell goes on to state that to many lavmen a broken back or neck is a broken back or neck, which results in sudden death or paralysis—total disability. This gloomy point of view is the heritage, he adds, of days before the introduction of the X-rays. With existing treatments most patients may he expected today to recover and return to their occupations

CELLULOSE PULP FROM AUSTRALIAN TREE

WOOD pulp for use in paper, guncotton. textiles, and the thousand other uses of cellulose may be grown on "tree farms" of limited acreage in the warmer parts of the south, through the adoption of a fastgrowing Australian tree, casuarina, is the belief of Prof. Donald D. Bode of the University of Tampa chemistry department

Casuarina trees will grow 35 feet high with nine inch trunks in six years, 56 feet high with 17-inch trunks in 12 years. They will produce from four to six cords per acre per year, as compared with one cord per acre per year for southern jack pine Moreover, a cord of casuarina wood is one fourth heavier than a cord of jack pine

The Florida state forestry service estistate that to supply a 200-ton mill with slash pine, 120,000 acres under forest man-agement are needed. The same mill could he supplied by a 24,000-acre tract of casua-

The tree can be grown on poor soil, down to the very edge of salt water. It must not be attempted, however, except where winter temperatures do not drop below a mean of 54 degrees, Fahrenheit, for the coldest month, and it must be carefully protected against fire, to which it is unusually sensi-

The casuarina is a strange-looking but beautiful tree. It has no leaves, their place is taken by extremely slender, long, jointed green-swigs, somewhat resembling the common horsetail or scouring-rush -- Science Service.

CRYSTALS

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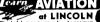
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OILED-EARTH PAVING

ONE day back in 1929, Paul E. Tignor, field engineer for The Glenn L. Martin Company of Baltimore, accidentally upset a small can of lubricating oil which he was using on his lawn mower in the back yard at his home. The oil penetrated a mass of red clay and Tignor, always of an inquisitive turn of mind, bent down to examone the oil socked mass of earth. He found that, in its oily condition, it could readily be mixed into a sort of dough

This gave Tignor an idea, and from that simple beginning he developed a wholly new paying process particularly designed for use on airport runways and which has subsequently been adopted as a standard surface in many municipal airports

At that time Tigner was seeking a longwearing, water-proof surface for a 1600foot airplane runway which he was about to construct for the Martin company at its Middle River plant near Baltimore He continued his experiments by mixing various types of oil, asphalt, and the like, with the native sand, clay, and gravel of the area until he found a satisfactory combination. That the formula was a good one has since been evidenced by the fact that the runway he laid down in 1930 is still in an excellent condition

CORRECTION

IN giving the dimensions of the roadway on the pontoon bridge across Lake Washington, at Seattle, in our February article, "A Bridge That Floats," it was stated that there would be 24 foot sidewalks This was a typographical error, it should have read "two 4 foot sidewalks."

TRICHINOSIS AND PIG INSPECTION

PRACTICAL plan for the eradication A PRACTICAL plan for the eradication of dangerous trichinosis, at a cost of from 25 to 50 cents per pig slaughtered, was presented recently by Prof. Thurlow Nelson, of Rutgers University, before a meeting of the American Association for the Advancement of Science. The plan depends, according to Science Service, on widespread use of a new, simple skin test for trichinosis developed by Drs G W Bachman, D L Augustine, and Hans Theiler It has been used successfully by the New York City Health Department during the past 18 months

"Every seventh to tenth garbage-fed pig slaughtered in this country today is wormy. infected with the most dangerous worm known to man" Prof Nelson declared. Humans eating the meat of such animals, unless it is thoroughly cooked, may develop the serious and often fatal malady, trichinosis. Federal health service estimates show that the trichinosis problem involves some 17,000,000 people, several

BEIVERSAL PHOTO ALMANAC AND MARKET GBIDE 1940

AMATEUR photographers who feel that they should be able to make money with their cameras will find in this book many hints that will be of value. A series of articles tells what, when, and how to photo graph, how to sell your photographs profitably, how to handle your equipment, what picture journalism consists of and how to make contacts with editors, and many other things that the would-be photo journalist will want to know. A pictorial section presents some of the work of this ountry's foremost photographers; a large formulary gives in compact form most of the standard formulas. The market guide section tells who purchases what kind of photographs, approximately the price paid, and gives other pertinent data regarding hundreds of publications that are in the market for photographs.

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hundred thousand of them suffering the disease, and probably several thousand dy-

ing from it every year.

By Prof Nelson's plan the new skin test would be made on every hog slaughtered, both in commercial packing houses and on farms slaughtering for home and local consumption The cost of this, once arrange

ments are made, need not be more than 50 cents per animal, and may be as low as 25 The New York experience with the test shows it is accurate to within less than 3 percent, and the error is in the direction of safety since, with one exception, all the mistakes made were diagnoses of trichina infection where it did not exist.

PROBLEM.

THE MEDIANS

HERE is another of Lieutenant Com-mander Kaplan's little problems such as we have been offering our readers for several months past, each time publishing the solutions in the succeeding month's 14



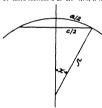
36" Compute the lengths of the three sides of the triangle so constructed That ought to be easy Send your answers or any letters about the problem to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40th St., New York, N. Y. and they will be forwarded, unopened, to him

SOLUTION TO THE

PROBLEM OF THE CHORD

AND ARC

TIEUTENANT-COMMANDER Kaplan's problem last month read as follows Find the radius r of the circle in which a 24' chord subtends a 25' are. Also, if that



seemed pretty elementary, try taking the following sequel to it in high gear. Deduce a series which defines the radius r explicitly in terms of the chord c and the arc aa series, that is which will permit numerical computation of r by direct substitution of the known values of c and a

How much real trouble one man can stast with just a few little words! Well, here are the solutions

The conditions of the problem are expressed by the following equations 2 r sin r - c 2 r x = a Dividing (1) by (2), we have $\frac{\sin x}{x} = \frac{c}{c} = \frac{24}{25} = .96000$

(3)

The value of x which satisfies this equation may be shown to be between .492 and .493 radians. An interpolation may be made for the mext two figures to obtain five place accuracy, as shown in the table below

x (radians)	sin x	sin x	
192	.47239	.96314	
49288	15'10 x 00100	= 00088 96000	
.493	.47327	.95998	

Substituting this value of x back in equation (2) gives

$$r=\frac{8}{2x}=\frac{25}{2(49280)}=25361$$
 ft (ans.)
To evaluate r without the use of trigonometric tables, sin a in equation (3) is replaced by its sures equivalent,

etric tables, sin x in equation (3) is replaced by its series equivalent,

$$\sin x = x - \frac{x^3}{13} + \frac{x^5}{18} - \frac{x^7}{17} + \frac{x^9}{19}$$
 (4)

sielding
$$\frac{c}{a} = 1 - \frac{x^2}{(2)} + \frac{x^4}{(2)} - \frac{x^4}{(2)} + \frac{x^4}{(2)}$$
Rewriting (5) and using the new variable z to denote the left hand side of the equa-

z to denote the left hand side of the etton,

$$z = 6 \ (1 - \frac{c}{a}) = x^3 - \frac{x^4}{20} + \frac{x^9}{840}$$

- x* (5)' The series shown in (5)' may be reversed* made explicit in a instead of z- by set-

 $x = z^{\frac{1}{2}} + \Lambda z^{\frac{1}{2}} + Bz^{\frac{1}{2}} + Cz^{\frac{1}{2}}$ then substituting this value for x in (5)', and placing the coefficients of the different powers of z separately equal to zero, thereby obtaining the values of 4, B, and C. The series thus reversed will be found to be

$$x = z^{\frac{1}{4}} + \frac{z^{\frac{2}{4}}}{40} + \frac{107 z^{\frac{2}{4}}}{67,200} + \frac{3197 z^{\frac{1}{4}}}{24,192,000}$$
(7)

To get a series which expresses r directly instead of a, the value of the latter as given in (7) is substituted back in equation (2). The capsizing of the series required by this operation may be accomplished by ordinary division. The resultant series is

$$r = \frac{1}{2\sqrt{\frac{1}{2}}} \left(1 - \frac{1}{40} - \frac{13z^2}{13,440} - \frac{1649z^3}{24,192,000} \right)$$
(8)

where, as already indicated in (5)' above, $z = 6\left(1 - \frac{c}{a}\right)$

For the specific values given in the problem,
$$z = 6\left(1 - \frac{24}{25}\right) = 24$$
 and

 $\mathbf{r} = \frac{25}{2\sqrt{24}} \left(1 - \frac{.24}{40} - \frac{13(24)^2}{13,440} \right)$ 1649 (24) ' 24,192, 000) = 25 3610 ft.



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EXHIBITS OF OLD GUNS

ATENTION, you gun collectoral There's A atteat in store for those of you who live in or near St. Louis, Missouri, and Seattle, Washington During the month of March The International Studio Art Corporation will establish a considerable number of the ancient firearms which were formerly a part of the William Randolph Hearst collection. They will be shown in St. Louis at Scruggs, Nanderwort & Barney's, and in Seattle at Frederick & Nelson's These guns are well worth seeing.

GUN PLANT GOSSIP

T was recently our pleasure to visit several of the New England small arms manufacturers and among this cordial group not only were the latch keys out, as usual, but also we were let in on a few little secrets concerning gun developments which will be disclosed later in the year. One thing we can tell, however, is that the proposed "History of Colt Revolvers," by Charles Haven and Frank A. Belden, will be published The response to the inquiry addressed to collectors and lovers of firearms by Colt's Patent Firearms Manufacturing Company as to whether the book would be well received was so spontaneously gratifying that it was determined to proformation it will indeed be a splendid volume of some 600 pages, 250 illustrations, and a 250 page appendix-one of the most complete books of its kind ever to be pub-

At the J Stevens Arms Company plant, Superintendent Frank T Green exhibited some interesting developments for future Stevens products, details of which we hope to be able to tell you next month. At the home of the Martin Firearms Company, A P. Curtis, Goordinator of Production, took us through the oldar and showed us



Pat Murray - bores barrels

"the works." It's too had that every owner of a rile, shogun, or revolver can't have that same providege. When you begin with the raw sired and wood and follow them through each of the hundreds of operations and processes to the completed product, you not only have a great deal more respect or your own firsterms, but you also come out with a feeling of increased confidence in the men who make gions. The care and



Fred Sloane - trained eves

precision which has gone into the manufacture of your favorite firearm is something which has to be observed within the four walls of a gun factory to be truly appre-

ciated For example, we watched Fred Sloane align a Marlin barrel Fred, it seems, had been around gun factories for a number of years before he came to Marlin in 1902. and he's one of the few men in the country who can be depended upon for the delicate and precise work necessitated in barrel We asked A P Curtis how it alignment was done, and the explanation was as simple as the job was persnickity. The barrel is held up toward a specially prepared light and Fred Sloane looks through it. If the barrel 18n't quite straight, there will be a shadow which only trained eyes can see. The quirk is removed by a machine process and then Sloane sights it again. This time it's clear, clean-cut, so Fred passes it on and it eventually becomes part of a Marlin gun.
Then there's Pat Murray, who started working in the Marlin plant away back in 1886, and he not only doesn't look it, but the barrels he bores from the raw tubes of steel prove that his 54 years with his prosent employer have made his eye keen and

his hand deft. Go where you will in American firearms manufacturing plants, you will find the Fred Sloanes and the Pat Murrays. symbolic of that precision, that care, that accuracy which has distinguished American gun making from the time of the early Revolutionary flintlock to the present day Garand rifle. In these days of international unrest it's comforting to know that we've got men in this country who can and do make some of the finest guns in the world

SPORTSMEN'S SHOWS

WHEN any one of the chaotic propensities of this weird world appears to choose our particular self on which to vent its spleen, we usually find soul satisfying surcease by smashing a couple of dozen "birds" on the skeet field, wading a rippling trout stream, or, mayhap, imagining we are drawing a bead over the rifle sights on our pet peeve of the moment. But through win ter months this panacea is not too easy to achieve, so we say "Bless the man who thought up the idea of the sportsmen's show!

There, for one glorious week in February or March of each winter one can utterly lose oneself among the myriad of guns, fishing rods, and everything that goes along with them. We heartily recommend a visit to your local outdoor show. It will sweep away the cobwebs of too much business strain and put you in tune with the openeie ectivities soon to be with us. As this copy reaches print, New York and Chicago, between February 17 and 25, will simultaneously he admitting new gun models or longing for that 4-ounce trout rod. On the heels of these exhibits will come shows in Philadelphia, February 26 to March 2, in Detroit, March 2 to 10, in South Bend, March 6 to 10, in Indianapolis, March 16 to 24, in Minneapolis, March 23 to 31, in Buffalo, March 30 to April 7, and in many other cities and towns hundreds of things to gladden the sportsman's heart will be on display

FROM THE MAILMAN

R C R asks if barrels of second hand shot gun, 1912 vintage, will withstand modern high power loads. . . Ans: Be careful of ancient barrels, especially twist, laminated, or Damascus Many ammunition makers now enclose slips of paper in shell boxes warning against use of heavy loads in old types of barrels.

P. R L. wants suggestions for authoritative books on firearms for beginner. . . Ans "American Shotgun" (Askins); "In The Gun Room" (Burrard); "The Rifle in America" (Sharpe); "Guns and Gunning (Curtis); "The Bird, The Gun and The Dog" (Sands).

Pot-Shots

AT THINGS NEW

BOOKS OF THE MOMENT include Dr John B. May's revised edition of "Natural History of the Birds of Eastern and Central North America," Ray Camp's "All Seasons Afield With Rod and Gun," and "Hawks in the Hand" by the brothers Frank and John Craighead. And speaking of books, if you haven't copies of the "Handbook on ShotBore Rifle Shooting" in your library, your bookshelf really san't complete. Both these mexpensive books are published by The Sporting Arms and Ammunition Manufacturers' Institute, we'll gladly tell you more about them if you're interested

BELDING & MULL (Geo McG Fryberger, Successor) have published a handbook (50 cents) on reloading and handloading of ammunition for revolvers, pistols, rifles, and shotguns which provides the powder putterer, both novice and old-timer, with practical suggestions on why and how to reload, on primers, powders, bullets, ballistics, tools, tables of charges, and accessories For beginners' benefit, unduly technical phrases have been omitted, but advanced handloaders will also find much of interest

ITHACA GUN COMPANY, in answer to field trampers' plea for a light, yet safe shot gun, has replied with Model 37 "Feather light" pump gun in 12, 16, and 20 gage at respective weights of 5%, 6, and 63, pounds, with every piece proof-tested at loads developing 715 tons pressure "Feath erlight" is available in any choke, has 5 shot capacity (with plug to conform to 3-shot Federal Migratory Bird Law), 24 inch chamber, 14 inch stock, drops of 1% inches at comb and 21/4 inches at heel, full pistol grip with gripcap, hand checkered stock and fore-end, and engraved receiver.

INTERNATIONAL RESEARCH CORPORATION. makers of the Argus cameras, have an ounced a new 55mm prisinatic spotting scope which has been acclaimed the "hot test" thing on the market. It is 14% inches long, weighs 43 ounces, comes with standard magnification of 20X and offers 14mm eve relief, thus providing comfort for gunners who wear glasses. Optional eve pieces of 128X and 26X may be had at alight extra cost and both are interchangeable with the 20X At 100 yards the Argus "Spotscope" offers a field view of 11 4 feet with the 20X. 165 feet with the 128X, 63 feet with the 26X. Metal caps protect both eye piece and objective lens during transportation

HARRINGTON & RICHARDSON ARMS COM-PANY, for convenience in carrying, pro tection against lost pieces, speed in prepar ing to shoot, offers a finely balanced single barrel shotgun in two frame weights, both equipped with black walnut stock, semi beaver-tail fore-end and auto-ejector. The 4% pounder has a 22 inch barrel, is cham bered for A10 and 28 gage, while heavier model, in 12, 16, 20, 28 and .410 gage, has 26-inch barrel and varies in weight from 5% to 6% pounds, depending on gage. The 410 in both models takes a 3-inch shell

REDFIELD GUN SIGHT CORPORATION offers to "X-ring" devotees a new streamlined (no projections to catch on gun case or clothing) precision rifle target sight with 60-minute elevation adjustment, eight individual quarter inch positions in a two-inch extension from front to rear and an 18minute windage scale in each direction When sight radius is changed by moving sight from one position to another, correct elevation is automatically maintained Scales are shown by dark figures on polished surface in 3-minute gradations with opposite side blank for individual markings.

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MOUNT YOUR PRINTS

AFTER you have gone through all the steps involved in turning out a photographic print in which you take particular pride, the job will remain incomplete unless you take the final step to give it proper display in a suitable mounting. The print does not have to be as large as 11 by 14 inches nor does the mount need to be a 16 by 20 inch exhibition size. Suit the mount size to the area in which the mounted picture is to be hung. A relatively small space may require a small mount, perhaps only 11 by 15 inches, in order to allow "breathing space" all around it. For about the same reason, a small print may look right on a large mount. It is all a matter of studying the needs of the particular print you are mounting, coupled with your own personal

The simplest method of mounting prints



Figure 1

is in an album, but the mountings we have in mind are those of exhibition caliberthe type than can be hung on the walls of one's home-ranging in size from about 10 by 12 inches up to 16 by 20 inches. For the best results, it is advisable to purchase the regular mounting boards available in photographic stores in several thicknesses and, as a general rule, in the regulation 16 by 20-inch size Some stores sell these mounting boards in smaller sizes. The most popular boards are white on one side and buff on the other, permitting a choice as the occasion arises, without having to pur-chase a number of boards of each color

Pictures may be mounted on single boards



Figure 2

or between two boards, with an opening cut out in the top board to the dimensions of the print. In the first case, the white print border if any, is trimmed off and the print mounted so that it adheres firmly over its entire surface. Adhesion is effected by using rubber cement coated on both the mount and the back of the print, allowing both surfaces to dry before laying the print down, or by employing some other adhesive, such as mounting tissue.

The second method of mounting, now very much in vogue, has a good deal in its favor, although it entails a little more trouble than the first. These double mounts can either be purchased ready made or cut at



Figure 3

home. The ready-made type are provided with an opening either for 8- by 10-inch or 11- by 14-inch prints. These may serve in most cases, but many workers will find it more satisfactory to cut their own for two reasons, they can cut the opening to any size they may wish without being re stricted by the two sizes commercially available, and; secondly, they can vary the effect of the opening by using top boards of varying thicknesses to obtain different beveling effects

The opening is cut with a sharp knife held at an angle against a guide of some sort. This provides the attractive beveled edge. A straight edge and a knife will do the job, but in order to assurd against the knife "wobbling" down its course, it



Figure 4

necessary to lay down a sheet or two of cardboard under the mount being out. Due to the popularity of the cut out mount, two mount cutters have been introduced on the market, the Xacto and the Cut A Mat, the latter making it possible to cut circular openings (See Figure 4.)

Conventionally, prints are usually placed on the mount so that the top and two sides are the same distance from the edge, leaving the space below the print about Iwice. more or less, the top dimension. This rule, however cannot always be followed as in the case of a long picture or a rather small print on a large mount. In such cases, the worker's personal judgment must guide the proper placing of the print

As a general rule, the color of the printing paper dictates the color of the mount to be used. For white prints use the white side of the mount, for buff or ivory, the buff aide

Figures 1, 2, and 3 illustrate the principal steps in mounting a print with a cut-out opening. Figure 2 shows the top board being set into place. The print is first centered on the bottom or base mount so that it will fit properly into the opening, and some dabs of rubber cement are applied all around the print on both mounts as well as a dab or two under the print itself. In this type of mounting, the white border need not be removed from the print because the top mounting board effectively

When the job is finished, use a block of

art gum to clean marks off the surface of the mount. Hang in an appropriate place either by using a gummed tab provided with a hole for hanging on a picture hook, or some such device as the Braquette ad nustable picture frames

QUANTITY PRINTING

MITHEN a number of prints from a single when the prints are quite small, as when making preeting chrds, it becomes a labori ous and tedious job to develop the prints individually. Normally, prints are exposed and dropped into the developing tray one at a time. However, if care is exercised it is possible to develop three or four small prints at a time After determining the proper printing time, expose a number of prints and keep them under cover. Take up three or four and immerse them in the developer solution at intervals of say five seconds. Thus, the second would be immersed five seconds after the first, the third five seconds later, and so on It is not too difficult a task to keep tubs on the prints and know which one went in first Besides, in a minute and half developing period, five seconds or so is not going to make much difference. Also, it does not have to be five seconds, the prints can be immersed rapidly one after the other so that all three or four are in within five seconds or less. If the five second interval scheme is comployed the prints will be pulled out at the end of the developing time in the order in which they went in

PRI-SETTING FOR ACTION

M NY photographic workers frequently experience difficulty in stopping the action of a moving object as it approaches the camera Usually the reason is that they attempt to focus the subject as it is moving This has two disadvantages you have to keep focusing up to the actual exposure, and the concentration on focusing causes you to forget the composition and pictorial interest of the subject uself. In other words you are so absorbed with the mechanics of the camera that you have no eye for the picture. The better way is to set your focus in advance on some given object which the subject is due to pass. When the subject



"Bumpety-Bump"

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reaches this point, snap the shutter and your picture will be sharp, particularly if you have stopped the lens down somewhat to provide depth of field "Bumpety-bump" was made in this way by pre-focusing on the post When the pony reached the post, the shutter was snapped Due to the dullness caused by an overcast sky, a longer anapshot exposure was required than was necessary to stop all movement. However, the result was satisfactory

PORTRAIT BACKGROUND SHADOWS

PORTRAITS that include three quarters of the figure usually give considerable trouble because of the problem involved of how to balance the subject, where to put the hands, and so on Illustrated here is one way to do it A bench was used, al-



"Durk"

though a box or similar object would serve as well in addition to a suitable pose and lighting, a shadow of the figure was prosected on the background by means of a low-placed spotlight Observe how this shadow not only aids the composition but also imparts a certain gavety to the picture that seems entirely suitable to this particular subject.

FOCUSING BY GHESS

MANY cameras are of the inexpensive type, which usually means a lack of any type of automatic focusing device, such as the range finder and reflex focusing conveniences So their owners must learn, at the very beginning of their photographic hobby career, how to estimate distances by sight. For close distances, such as those required with close-up supplementary lenses, it will doubtless be found necessary to use a measure of some kind; for work at longer distances, distance-estimation by guess must be resorted to.

Some persons get it quickly; others re-quire considerable experience before they catch on. A standard method of learning to estimate distances is to look towards a subject a certain distance away, make a guess at the distance and then measure the distance to see how close your guess was. Another way is to look at a piece of furniture, such as a sofa or a long table and

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fundamental requirements. Once you find out how your camera works, learn how to make correct exposures, and master the basis of composition, your camera results will show immediate improvement. You need not wade through text books, dry treatises, in order to obtain this information. Into "So You text books, dry treatuses, in order to obtain this information. Into 30 100 Want to Take Better Pictures, "the author, drawing on a varied experience in photography, has packed just the things you need to know. Questions and problems have been anticipated, answered in detail, for the camera owner who has his developing and printing done at the photo shops. Written as a running stroy of your camera and how best to use it.

Chapter Summary: What Your Camera Does; Equipment for Better Photography; Indoor and Outdoor Pictures, Portraits; Action Photography; Candid Pictures, Angle Photography; Color, Tricks with Your Camera, Troubles and How to Overcome Them.

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make a guess at its length. Another is to master a basic distance estimate of any five feet and judge all distance in units of five feet. Each worker discovers some little method of his own The fact is that most amateurs do preity well at guess forcusing, even though it is considered that medium small stops are used

Is CHROME ALUM STABLE?

THIS question, propounded in Foto Retiew, and one frequently asked by amateur workers, is answered fully and authoritatively by Mr LeRoy Roselieve The answer follows:

"Chrome alum in its dry chemical form is farrly stable and may be kept for a long time in the original container. However, both extends the container and the containing chrome alum do not keep well as the chrome alum beak down very rapidly in solution in the presence of an acid Hency, colutions containing chrome alum hould be clanged often in order to realize the full benefit of the hardening properties of chrome alum title! Particularly step baths used between development and firstion of development and firstion of the containing the conta

CANDID PHOTOGRAPHY IS STILL WITH US

THE ministure camera statisted out years ago as a convenient medium for shooting pictures of people candidwise, and it appears that the magic of the word "candid" still fills the air A great many persons till look upon the ministure camera as a dandy way of getting pictures of people when they article looking. We know that today many so-called candid pictures are taken not only with the awareness but also with the cooperation of the subject, and the arrangement has an fact, proved to be tissued to treat the cooperation of the subject, and the arrangement has an fact, proved to be tissued to the arrangement and the subject and the arrangement and some factors of suitable lighting arrangement and nooning.

The accompanying illustration is an example of pure candid and was shot at 1/2 8, 1/50th of a second, during an outdoor bene-



"The Artist"

fit. Both subjects were absorbed in their separate tasks, the one at the easel, the other posing, so that the photographer was able oshoot without disturbing either, yet under suitable conditions, both as to lighting and

THE INTIMATE TOUCH

WE don't know how the print "New Mlampshire" will strike our readers; we are reproducing it as a bit of self-indulgence in the hope that it may strike a response in others of our readers with like interests. Why did we select this subject during a lessarely walk along a country



"New Hampshire"

road in New Hampsbure? Well, chiefly because it was a piece of lands-api trumovel from all the surrounding controlled from all the surrounding controlled for the form and the surrounding controlled for which a confortable towering angle that, in a small, intimate space, told the whole story of the uniquely beautiful New Hamp shere countrivated. The lighting was delightfully right and the small cloud strategically "stopped" in the only place in the picture where it fitted best. Somehow even the size of the cloud, and it is shape, are appropriate A bigger cloud or a smaller one, or one of different shape, maghs have vessed out of

AMIDOL DEVELOPER

NoR greatest transparency in heavy shadows and a rich blue black color whin enlarging on brounde papers, a de valoper that has been the favorite of many earnest workers for years is made up from the amidol formula. One of the principal reasons why it does not enjoy the wide popularity that it deserves is its perishable nature. It does not keep and must be made up at the time of using For those interested in trying the formula, here it is:

Develop at 65 degrees for two to three



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PANORAMA

WITHOUT TRIPOD

O'E of the most interesting pictures made by amateurs during the course of the New York World's Fair last year, was a panoramic shot taken without benefit of tripod of angle calibrations. Mrs. Dora K Howe, of the London Terrace Camera Club (New York), who made the picture, says she used the surface of a stone ledge, swinging the camera around from left to right of the Court of Nations area, halting for exposures at each turn. In all, she made four exposures which, by overlanging slight ly at the edges, gave her a continuous panorams of the scene with the exception of one joining, where the clouds failed to mesh This she plans to correct with pencil work

POSING TIPS

HFRE are a few hints that will help you to determine camera position, lighting, and so on, for various types and situations Long Face Camera should be above the head, with latter at three quarter angle Broad Face Camera level, shooting almost

profile. Pug Nose Camera above head, nearly full front, with head bent

Long Neck Camera above head, bend head

Buld Head Camera below, front lighting. reflection from below at one side Furrowed Face Diffused light, flat lighting High (heek Bones Broad front lighting Hollow Cheeks Front, side lighting.

Full Length and Group Flat top lighting. sereened toward floor Babies Camera low, flat lighting

Hands Edgewise to camera or nearly so, shade with screen

KEEPING DEVELOPER

SOLUTION

OR ideal preservation of developer stock I solution, it is recommended that the bottle be kept full at all times. The usual method of achieving this is to have on hand a supply of marbles and drop in a sufficient number to keep the solution near the top Another method recently suggested to us by a druggist is to turn the bottle upside down The liquid scals the opening and makes it sir-tight Sounds reasonable enough. The only difficulty would be in keeping the bottle upright when standing BOOKS_

ROOKS BOOKS o

r Amateur Photographers

New WAYS IN PHOTOGRAPHY, by Jacob Deschin. Eminently practical from every point of view, this new hook contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another. It covers the whole range of amateur photography. discussing such things as truk photography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner. \$2.85.

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WHAT'S NEW

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FILMO MASTER 8 PROJECTOR Features rack and pinion tilt, whereby picture is positioned on screen by turning knob, centrained switch panel, with separate controls for lamp and motor mounted on prosector base, radio interference eliminator. allowing radio music in same room during projection; lens-lock permitting projection lens to be locked in position after focusing Finished in chony black, with chromium trim Has Bell & Howell film-protecting. ande tension feature, framing device, takes 300, 400, or 500-watt lamps

NIKOR PRINT WASHER (\$4.75, \$7.75) Prints (and films) washed by device by tween leaves of vertical "book" made of specially processed absorbent fabric Prints cannot touch each other Filtering action of cloth assures clean water Rubber hose, approximately 3 feet long, attached to faucei by means of tapered connection. Supporting frame made of stamless steel. In use takes one third space of tray, not in use, folds flat Available in two sizes 8 by 10 inches and 11 by 14 inches Size 8 by 10 accommodates fifteen prints this size, or equivalent area of smaller prints. Size 11 by 14 takes 15 prints this size, thirty 8 by 10, and so on

SUPERFLASH SUNDER No. 2 Incorporates own daylight blue color correction filter to change color temperature of light source to equivalent of bright sunlight. Its use with any regular daylight color film, indoors or outdoors, without a filter, said to produce natural color reproduction with all colors in their correct relation to each other

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MINI-FLASH FLASHCUN (\$12.50) · Compact flashgun featuring folding reflector, made of eight sections folding together, fan-like, when synchronizer not in use. Will not throw "spot" of light. Uses "fountainpen" type flashlight batteries Synchronizer may be used on any camera Shutter-tripping and bulb-flashing mechanism entirely mechanical May be attached to camera by means of "shoe" or directly on tripod socket, connection for which is furnished with each gun.

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Kemp Adjustable Print Washer (\$1.50) Designed on scientific principles for thorough print or negative washing Con stantly replaces hypo-laden water drawn off from bottom Equipped with three-foot hose easily strached to faucet and held securely to bottom of sink by vacuum cup, creating gentle whirlpool action, keeping prints apart

Acra Eveready Tripod Case (\$1.75) Eveready-type carrying case for use with No 1 and 2 Agfa metal tripods Per mits use of tripod without removing entirely from case Case made of selected top grain leather provided with slide fastener closing device.

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JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by muil, enclose a stamped, addressed envelope Queries should be specific, but Mr Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials -The Editor

Q. I have a . . . camera and the reg-. Photoflash attachment, but I have had trouble from the start with the flash equipment. I am using Wa-bash Press 40,000 bulbs, speeds of 1/50 and 1/100 of a second, at about f.5.6 and f/8. My pictures lack detail mostly in faces and are also lighter on one side than the other, as you can see by the enclosed pictures. What am I doing wrong? Incorrect flash lamp, time, or lens opening? My camera has a focal plane shutter. What do you ad--A. D.

A. From the looks of your prints, we would say that, for one thing, all of them are completely out of focus. Secondly, the bulb you are using is not recommended for focal plane shutters, you should use the No 2, which has a longer "peak light" to allow ample time for the focal plane shutter to slide across the film while the light is at its peak. The lack of detail in the faces is due both to over-exposure and poor focusing, the uneven density of the negative is probably due to the wrong type of bulb Use the No 2 and if you still have this latter fault, return the camera to your dealer and have him check it

O. Out here on the desert I am constantly being "fooled" by the light, over-exposing negatives. Then I think I must be over-developing them for they are extremely dense. To illustrate: My printer has 160 watts of light within three inches of the printing frame and with average negatives I expose the paper from two to eight seconds, yet with these dense negatives I must expose them for two or three minutes before even a faint print is obtained. Is there any process by which I can reduce the density of these negatives?-C. S., Jr.

For reducing over-exposed negatives, the following two formulas are generally recommended.

Permanganate Reducer

Stock Solution A 32 ounces Water . . . Potassium Permanganate 1% ounces Stock Solution B

Water Sulfuric Acid, CP. (add acid 1 fluid ounce to water)

For use take 1 dram (4 cc.) A, 2 drams (B cc.) B. and B ounces (250 cc.) water. When negative has been reduced, place in fresh acid fixing bath for few minutes until yellow stain disappears, then wash

Farmer's Reducer Stock Solution A

Water 16 ounces Potassium Ferricyanide (Red

Prosecuted .. 11/4 ounces Stock Solution B Water 64 ounces

Hypo 16 ounces When ready to use, add I ounce of A to 4 ounces of B, then add 32 ounces water Pour over negative and watch progress

For correcting over-developed negatives, the following is recommended

Proportional Reducer

Stock Solution A Water . 32 ounces Potassium Permanganate 4 grains

Sulforic Acid (10% sulution) . . 1/4 fluid ounce

Stock Solution B Water Ammonium Persulfate 3 ounces For use, take 1 part of A to 3 parts of B After reduction, clear in 1 percent solu-tion sodium bisulfite. Wash thoroughly To make 10 percent solution sulfuric acid.

add I part acid to 9 parts water while stirring Before treating negatives to any type of reducer, negatives must be thoroughly washed free of hypo and if allowed to dry should be immersed in water until limp

O. Will you kindly tell me what is the approximate amount of silver on a thousand feet of 35mm film, unused?--H. A. S.

A About an ounce of silver is used in the emulsion on a thousand feet of this size film, the exact amount varying with the different emulsion formulas

Q. I am contemplating building or purchasing an enlarger and want to se in it the lens from my camera. Would the light from the enlarger damage the lens?—C. L. H.

A. If a normal enlarging bulb is used in the enlarger and there is provision for proper ventilation, your camera lens may safely be used in the enlarger As a matter of fact, this is a regular practice with several well-known makes of cameras, the lenses of which are generally used interchangeably on both camera and enlarger.





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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

TESTED blueprints — give us tested blueprints else we perish — was the burden of several frantic letters recently received by this department from a single individual. Ametier telescope makers, these letters urged, should do their work from tested blueprints. Yet tested blueprints didn't seem to be available, so something's wrong.



Figure 1: Simpson's double-ender

If anateur telescope makers were the kind who craved tested bliegerints and dark whated to copy some standard model, even if it might be a bit better, something really would be wrong. Instead, they manyle go telescopes and then cook up their own cornecte expression of them. The result has been an almost infinite and endlessly in the contraction of the cook of the

Below are a few more of the infinite variety of telescopes, each one of which agave its maker some fun, not alone in making but in planning, and after all, suit fun the chief commodity sought when a man decides to make a telescope?

THIEF feature of the instrument shown in Figure 1 is the combination on one axis of an 8" f/45 Newtonian RFT, the lower telescope, for star fields, and a 123/2" Cassegrainian, the upper one, for lunar and planetary observation, that is, one telescope for broad, general views and the other for restricted, particular views. Incidentally, this arrangement on one axis brings both evenieces to about the right height for comfort. The maker is J. F. Simpson, a medical and X-ray technician, Garrison General Hospital, Gastonia, N.C. He states that, in place of the two forks, he believes a perhaps better mounting would be a long, heavy double voke, with the two tubes mounted in tandem within this same simple yoke. He also plans to substitute a 121/2' 1/5 RFT for the present 8" RFT, and to add a motor drive, so that objects will not move out of the field when the user steps away to permit a visitor to look-one of the annoyances of showing the stars to the totally mexperienced.

IKE the telescopes themselves, housings IKE of them afford an infinite opportunity from the maker's desire for vanet's Figure 2 is a housing of the dome type made by Edison T Schaefer, Schulenburg, Tex The concrete pier on which the telescope rests a viable in the photograph, within the wooden fabrication which supports the floor, walls, and dome. The latter has a 30" slot.

The telescope within (Figure 3) is a 10", f/7.6 of the Springfield type and Schaefer describes it as follows.

"It is controlled by mean of three electric motors, not the switchbard (Figure 3). The declination motor is turned on by one switch and reversed by another It turns at 5000 rp m. and is geared down to 230, also two slower speeds, by means of a 500ohm resistor and two push button switches. The R.A. motor is the same as the declination motor and is hooked up to drive forward to be a support of the same time of the same speed. Maximum speed, 180° in two minutes For sidertal time at third induction motor is used with rhoostat control. This gives sufficient actuacy for photographing, the Moon."

Figure 2: Schaefer's observatory

IN transmitting the photograph shown in Figure 4, Rudia I Fagard, Aguiler alia 27, vantago de Cuba, Cuba, states that he wanted an ordinary astronomical telescope plus equipment for measuring position angles of celestical objects, determining goographical coordinates, and so on On the cycpiece and of the tube, which notates, is a circle divided down to 5° spaces and opposite on the fact these is a raticle in the eyepiece, made of threads. The whole is farly simple and, while it splits no small hairs, it does what it was built to at was built to a twas built to a twas built to a transmission.

"To illuminate the reticle a flash-lamp bulb in front of a diaphragm near the middle of the tube throws light forward, some of which is reflected back from the back face of the objective lens, resulting in a perfectly even, yellow illumination of the field of view and of the micrometer, against which the stars stand clearly (The accuracy of this telescope is not so great as to make one consider the lamp's heating effect).

"I have many times found the latitude of my town by the zenith method, also the longitude by means of the Greenwich time transmitted by radio from London In determining the latitude by the zenith method I used B Cassiopeia and B Cetus which have zenith distances about the same in my latitude For the latitude of Santiago de Cuba I found 20° 1' 15" ± 30" which is in close agreement with the latitude found years ago by a commission from U S. A I have found that my telescope can work every time within an error limit of + 30' in latitude and ± 12s in longitude With this instrument, which costs not over \$15 in all. I have been able to practice many problems of astronomy and navigation

M ORE about the Cavola test Recently was excite, in corresponding with Cvril C Wates, 7718 Japper Ave, Edinon, Alta, Canada, sand he wished someone would describe the new Cavola test, all luded to in our last two numbers, in about eleven words of one syllable or less, and here is what Wates words in Pyllable or less, and interlarded comment by N J Schell, 1019 by our terribe.

"In the Gavola test, an optical surface is regarded as bone joint up of a large number of small surfaces, each having about 125 (for example) the diameter of the shole mirror A series of these small surfaces, each which is regarded as sensibly spherical, is solited by suitable masked (Figure 5, I), and the caster jointon of the center of curvature of each element is determined by a new and very accurate

"In the case of a truly spherical mirror, the center of curvature of all elements is situated at one and the same point — the C of C of the whole mirror (Figure 5, II), but in the case of a paraboloid (or any



Figure 3: Schaefer and telescope



Figure 4: Fajardo's instrument

other shaped surface), the centers of curva ture of the elements do not coincide In stead, they form a more or less irregular conic surface in space. A cross section of this spatial surface is a curved line on either side of the axis, which Gaviola calls a caus tic " [The envelope, or general shape, traced out by combining or linking up parts of the several reflected rays shown in the lower part of the drawing on page 283 of "ATM" is a caustic It looks like a big (, rather small at the top. It is true, this parenvelope of parallel rays reflected by a sphere but if, instead, one were to use rays from a pinhole that is, diverging rays -

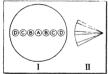


Figure 5 In re Gaviola test

and reflect them from the parabola in the upper part of the same drawing, one would get a caustic instead of the focus shown. The heart of Gaviola's test is that it is done along the caustic, and is therefore more nearly exact. Exactness in practice is a relative matter Strictly speaking, our everyday assumption that our reflected rays come to foci along a straight line is not guite correct - though most of us will have to exhaust the full degree of exactness and skill contained by the old test before we venture into this more exalted realm of precision. Even if we never get there at all we shall, however, be curious to know what the test is all about, hence this little duscussion.-Ed.1

"By the application of suitable formulas this caustic may be reduced to a graph of the actual surface of the mirror, either with reference to a true sphere, or with reference to any one of a family of paraboloids, just as we do with the Foucault test, by placing the knife-edge at various positions, inside or outside of the mean center of curvature. "In Figure 5, I, is the surface of a mirror

with a series of small isolated elements. In the Foucault test these elements or zones are measured directly on the axis in pairs, A, BB, CC, DD, and so on. In the Gaviola test they are measured individually, but along the caustic, and their relative displacement is thus determined.

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THE BEGUNER'S CORNER

NOT alone some beginners but some others also appear to think that the best seeing, through the telescope, will be had when the stars look brightest and sharpest to the naked eye. It could be, but generally isn't. Some recorded oral comment by the widely known advanced ama-teur observer. Dr W H Steavenson of England, reprinted from the ever-interesting Journal of the British Astronomical Association, is instructive,

"The word 'seeing' should be taken as referring merely to the quality of the telescope image Many beginners have the impression that bad seeing means every thing that was described by the late T W Webb as 'an impediment to distract vision

"I will deal first with the question of transparency, which is really quite distinct from the question of seeing. Transparency is, of course, primarily of importance to those who work on faint objects in towns, on account of scattered light. The mexperienced is apt to get a mi-leading impression of the effect of a slight increase in transparency, since an extension of 0.3 magnitude in the limit of visibility nearly doubles the number of stars to be seen

"I will now deal with the question of seeing proper, which means the definition of the telescopic image. It is often best under conditions of bad transparency. There are two possible sources of disturbance, the true atmospheric conditions, due to air currents at great heights, and local disturbances low down, often in the tube of the telescope These latter are the ones

which can often be avoided. The best way to find out where the trouble lies is to put a bright star out of focus, racking the eyepiece out and using a high power The outof-focus image may often be seen crossed by parallel lines or streams moving with great speed These are due to air currents at great altitude, often as high as 50,000 feet. They are generally most evident just before changes of weather begin, but they are consistent with quite calm conditions at seadevel

"At other times the focused image may be quite sharp, but it goes slowly in and out of focus All slow changes mean disturbances inside the telescone. There are two forms of these disturbances, mirror currents, which usually are only serious with large mirrors of twelve inches or over, and tube currents. Mirror currents, which consist of air currents in close contact with the surface of the mirror, show themselves in the out-of focus image as wavy lines slowly creeping across the image in a direction at right angles to their length. Tube currents are much more common, and give rise to a sorius of vortices in the out offocus mage. It should be noticed that any disturbance far outside the tube is generally rapid and is seen in the form of straight bucs in the image. It is well to remember that refractors may also show tube currents, and the fact that they are not commonly recognized is due to the fact that large instruments of this type are not generally used under the same exposed conditions as reflectors of similar aperture

Beginners who want to go a bit deeper into these matters will find that a chapter entitled "Atmosphere, Telescope and Ob-server," in "Amateur Telescope Making — Advanced, 'companion volume to "Amateur Telescope Making," is instructive

TELESCOPTICS

(Continued from preceding page)

spherical mirror it is assumed that the C of (of any given pair of elements or zones occupies a position somewhere on the onaxis of the mirror, but this is not absolutely true, as may be seen in Figure 6. at 111

"In the Foucault test, the knife-edge is made to cut the portion of the two cones of rays, common to both (shown blacked out), and the operator tries to make the shadows reach the centers of the two zones simultaneously. This is made more difficult by the fact that the shadows move at different speeds

"In the Gaviola test, the knife-edge is placed at A and B, these being the points at which each separate element, a and b, appears spherical, that is, darkens evenly all over. By means of very accurate micrometers the distances 2x and v are measured. The fact that this must be done with an accuracy of about 1/20,000 of an inch makes the test unsuitable for most amateur workers But I have no doubt that someone will overcome this difficulty" [The test consists of measuring a lateral displacement smaller than the usual longitudinal displacement, but provides means for doing this with an accuracy 25 or more times better than was possible with the older method. Its useful ness over the older method applies particularly to mirrors of focal ratio shorter than f/6. Very careful construction of tester, and very rigid supports, are required

Carrolla recommende masonry supports. As an indication of the values to be measured, with stationary light source, the y figure is approximately three times the familiar R, and the 2x figure is approximately r2/R divided by the focal ratio Both of these are, of course, to be taken from the mean of each zone under test -N J Schell 1

"Although the test as described can be done with the conventional knife-edge, Gaviola prefers to use a double knife edge in the form of a thin wire. In his article in the November Journal of the Optical Society of America, he describes three methods of observing the image of this wire, with and without an eyepiece, and comments that any of these methods is more sensitive than the accuracy of any micrometer screw.

"Having measured x and y for all zones, these measurements are then applied to the formulas, and a graph drawn of the surface of the mirror, which may be done within less than 1/100 of a wavelength.

The surfaces of the zonal elements may (and do) vary in two ways. They may change their curvature, and they may tilt, These two changes cause corresponding movements in the C of C — longitudinal and transverse, as shown by the arrows in Figure 5, at IV The Gaviola test provides for accurate determination of both of these variations - the Foucault test does not.

"The beauty of the Gaviola test lies in the fact that individual judgment of shadows passes out of the picture. One is testing a series of spheres, and the sphere is the

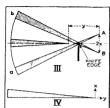


Figure 6 Concerning Gaviola test

some TN, will develop a modification of the test suitable for amateurs who do not possess expensive micrometer apparatus, remains to be seen. In measuring a 6 inch mirror (1/3), the maximum value of x is less than one tenth of an inch, which means pretty delicate technique! One of my brainwayes is the suggestion to try two plates as a condenser, in an oscillating circuit, in place of a micrometer, to measure

JOINING two sheets of HCF is a necessity in cases where the desired lap is wider than the standard widths (8" and 1014") of HCF will afford, and in "ATM," p 367,



Figure 7: Marrying HCF and HCF

a method of welding these sheets edge to edge is described. An alternative method which requires less of the art of leberde main has been communicated by Horace II. Selby. First, he trims the two sheets back from the edge a little way, in order to get into uniform material, so that a careful crosswise match between the cells is possible. Then he slides one of the pieces along the other till he has a precise length-wise match between cells. The sheets are now ready for permanent joining. This he does with an ice pick, very hot, which he touches very lightly and quickly to the cell slopes at their respective junctions, skipping alternate slopes (the down slopes) and filling these in later by turning the sheets around and repeating the process (Figure 7). He says it takes only ten minutes to join pieces of HCF for a 15" lap.

PITTSBURGH is to be the mecca for all on Friday, Saturday, and Sunday, July 5-7, and there will be plenty to do and see while there. This is in addition to the annual Stellafane get-together, to be announced here later.



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LEGAL HIGH-LIGHTS

Pater rade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar

VARICOLORED

THE owners of the trade marks "White Horse" and "Black Horse" for Scotch whisky successfully opposed an attempt by another to register the trade mark "Red Horse" for use on cordials, brandies, rums, cocktails, and similar alcoholic beverages In the case in question the owners of the trade mark "Red Horse" for alcoholic bev erages attempted to register it in the United States Patent Office The owner of the Horse' opposed the registration on the grounds that the trade marks were confusingly similar to each other. The Patent Office decided that the marks were confusingly similar to each other and sustained the opposition. On appeal to the Court of Customs and Patent Appeals, the Court pointed out that if the appellant were permitted to register the trade mark "Red Horse," other producers of alcoholic beverages might attempt to register the trade marks "Brown Horse," "Gray Horse," "Sorrel Horse," and "Bay Horse" and con cluded with the following

"That the use and registration of such marks on alcoholic beverages would destroy the value of appellee's registered marks, is so apparent as to require no discussion.

HAM AND EGGS

A SUIT of more than usual interest in-volving the so-called "Ham and Egg Pension Plan" was recently filed in the Federal Court in California

The suit charged copyright infringement and was brought by the proprietor of a copyright for a book against the Secretary of State of California The copyrighted book described an old age pension system similar to the pension system submitted to the voters of California last November and popularly known as the "Ham and Egg Pension System" The purpose of the suit was to restrain the Secretary of State from distributing to the voters of the state, as required by California law, the proposed constitutional amendment providing for the pension plan A motion was made on behalf of the Secretary of State to dismiss the suit and during the course of its conaderation of the motion, the court pointed out that a copyright for a book did not protect ideas described in the book but merely the language describing the ideas Since the copyrighted book described a pension system to be operated by the Government a governmental unit could operate such a system without infringing the copyright. The court then concluded that to operate such a system it was necessary to adopt suitable legislation putting it into effect and the publication of such legislation did

not constitute converght infringement. In this connection the court stated that "a plan or system advanced for government adoption cannot be convergited so as to prevent the publication of that plan or system, whatever the medium of expression used in the form of a proposed law incident to its submission to the vote of the electorate."

As a result of its conclusion the court dismissed the suit

VITAMIN C

A RECENT attempt to obtain a patent on Vitamin C, the anti-scorbutic factor, met with failure. An application was filed for a natent on hexuronic acul a white crystalline solid identified as Aitemin C The application was rejected by the Patent Office on the grounds that hexuronic acid had previously been isolated from the adrenal glands of animals and had been described in a printed publication pub lished some years ago prior to the filing of the patent application. The applicants for the patent conceded that bexuronic acid had been isolated from adrenal glands and had been described in the publication, but pointed out that the previous discoverer did not appreciate that hexuronic acid was the same substance as Vitamin C. but merely referred to it as a "reducing factor" The Patent Office, however, rejected the application, pointing out that the substance itself was not new and that a patent could not be obtained for the discovery of a property or characteristic of a substance nor for the discovery of the actual identity of a substance

Upon appeal to the Court of Customs and Patent Appeals the Court affirmed the rejection of the Patent Office stating have hereinbefore concluded that ordinarily no invention exists in the discovery of a property possessed by an old substance . . .

SECRETS

WHERE secret formulas become involved in litigation the court will attempt to preserve the formulas from publication. This is illustrated by a suit involving a secret formula for an alloy used in the manufacture of flat-ware and hollowware. The suit involved two manufacturers. each claiming to be the exclusive licenses of the owner of the formula. One of the defenses raised was that the formula was no longer secret but was fully described in a printed publication. If this were true the formula of course would be public property and neither party could restrain the other party from using it.

In order to determine whether the pub-

lished formula was the same as the secret formula it was necessary to take testimony as to the nature of the secret formula and if the testimony were taken in the usual manner the information as to the nature of the formula would be available to the public and the secret character of the formula would be destroyed. To protect the owner of the formula against this contingency the court ordered that the sestimony should be taken in camera and should be then sealed and submitted to the court, stating

"Having in mind that the taking of evidence upon the question whether the published formula is the true formula, and whether if so its dedication to the public is a dedication of the process, may threaten exposure of both formula and process if they be still secret, evidence may be taken in camera and sealed as was done in A O Smith Corp v Petroleum Iron Works Co.

MANUFACTURE

THE manufacturing of an infringing article even though the article is never sold or placed into actual use, constitutes patent infringement. This question was considered in a recent case involving patents for tractors It was contended by one of the parties that the court did not have jurisdiction over the suit because a tractor charged to infringe one or more of the patents had not been sold or used The Court pointed out that this contention was without ment because, if the tractor infringed the patents, the mere manufacture of the device constituted patent infringement. In this connection it would be well to note, however, that the failure to use or sell an infringing device would affect the or use of an infringing device it would be difficult to show that the patentee had suffered any damages or that the infringer had realized any profits

MERCILESS

AS pointed out in a recent federal court decision, the nature of a patent is such "that joint owners in it are at the mercy of each other". In the suit in question a patent for an electric fan was jointly owned by two persons One of the joint owners filed suit against a manufacturer of electric fans charging infringement of the patent and the other joint owner refused to join in the suit. To meet this situation the first joint owner joined the other joint owner as a defendant in the suit. The manufacturer of electric fans made a motion to dismiss the suit on the grounds that joint owners of a patent must join in the suit as plaintiffs The Court first considered the peculiar nature of patent rights, pointing out that where a patent is jointly owned either co-owner may manufacture, use, and sell the patented invention without the consent of the other co-owner and without hability to account for any profits realized from the invention. The Court also pointed out that one joint owner may grant a license to another person without the consent of the other co-owner and may collect for his own use the royalties arising from the li-

The Court concluded that to maintain a suit for patent infringement both coowners must voluntarily join in the suit and that if either co-owner refuses to do so he can not be joined as a party defendant,

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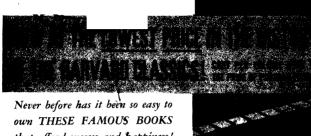
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M NINETY-SIXTH YEAR ORSON D. MUNN, Editor . CONTENTS . APRIL . 1940 Personalities in Industry-Thomas H. Chilton. . . Green Dragon of the Tropics-By Charles Morrow Wilson Chemistry in Industry Mending Paste Plastic
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more to the sirways, in private planes, in order to keep in personal touch with activities within widely spread organizations. A welldesigned example of planes that are being so used is the Spartan Executive type illustrated on our front cover. This particular ship is used by the Halliburton Oil Well Cementing Company to fiv executives to oil-field jobs all over the country.

SCHEMITTIC AMERICAN ADVI 180 Vo. No. 16; No. 4, emissed at the New York N Y. Post Office as second class matter June 28, 1879, under the set of March 10 of 1179. defilicate intry at Compact Com. or of March 10 of 1179. defilicate intry at Compact Com. The Property of the Compact Compac

Telescoptics

Current Bulletin Briefs

Legal High-Lights

Crown Caps Bubble Tower Thatched Roof O-Ke-Doke

O-Ke-Dol Mammy Parcheesi

Personalities in Industry

WHEN Thomas H. Chilton, director of the du Pont Company's Technical Division, Engineering Department, was awarded the Charles Frederick Chandler Medal several months ago by Columbia University, he was cited "for his outstanding achievements in the dis covery and formulation of principles underlying the unit operations of chemical engineering, and in the application of these principles to process develop ment, to equipment design, and to chem ical plant construction and operation

Honors came to "Tom" Chilton early in life. As an engineering student in Columbia he received the Illig Medal for "commendable proficiency in the regular studies" He is a member of Tau Beta Pi, Sigma Xi, and Phi Lambda Upsilon His portrait in the Engineering Alumni room at Columbia bears the designation "Leader in Fundamental Research '

Mr. Chilton was born in Greensboro. Alabama, August 14, 1899. He attended Starke's University School in Mont gomery, and graduated from the Lanter High School in 1915. His college career began in the University of Alabama, which he attended one year as a student of chemical engineering. Then came his transfer to Columbia University, which he attended five years. He graduated in 1922 with the degree of Chemical Engineer In 1918 Mr Chilton was en rolled in the Columbia University unit of the Student Naval Training Corps

While a student in Columbia, Mr Chilton served two years as assistant in the Department of Chemistry and one year in the Department of Mechanics He still serves Columbia as Lecturer in Chemical Engineering Extension and as a member of the advisory committee for the Chemical Engineering Department. He also serves Johns Hopkins University in a similar advisory capacity

Following several years' association with F J. Carman, on chemical research in New York City, Mr. Chilton joined the du Pont Company in 1925. Here Mr. Chilton was first assigned to the development of the pressure process for the oxidation of ammonia for the production of nitric acid, and he carried on this work during the period from 1925 to 28. He was also engaged in the



THOMAS H. CHILTON

installation of ammonia exidation units for the supply of nitre for chamber sulfuric acid plants. In 1928-29, he was engaged upon studies on the improvement of the contact sulfuric acid process In 1929, Dr C M. A Stine, then Director of the Chemical Department. authorized, as part of the fundamental research program of the du Pont Com pany, studies in chemical engineering, and a group of engineers was assembled for the purpose. Initially under the supervision of Dr John H. Perry, the direction of the group was assigned to Mr. Chilton before the end of that year The group was gradually enlarged, and in 1935 it was consolidated with a partly parallel group organized in the Engineering Department in 1932, under Henry B du Pont, as Head of the Technical Division. Mr. Chilton was named as assistant division head, and in 1938 succeeded Mr du Pont as division head.

The objectives of the group are the development of widely applicable design data for chemical process equipment Studies have been made on fluid flow, heat transfer, crystallization. distillation, adsorption, absorption drying, extraction, filtration, agitation, and other unit operations.

Mr Chilton served as a director of the American Institute of Chemical Engineers for three years and is Chairman of their Committee on Papers. He is active in the American Chemical Society as a member of the editorial board of the Technologic Monographs.

Despite his many interests in industry. education, and in scientific and fraternal societies. Mr Chilton always has time for his associates and friends. He confides, reluctantly, that he has one hobby, that of collecting automobile registration plates of the various states. However, those who know Tom best believe his real hobby is chemical engineering.

50 Years Ago in . . .



(Condensed From Issues of April, 1890)

ROADS.—"Prof. Ely, of John Hopkins University, estimates that poor made cost the farmer, on an average, \$15 per hove, and Pope Indiana, of Knox College, Illinois, argues that with good permanent Jenks, of Knox College, Illinois, argues that with good permanent roads freight could often be hauded ten miles on wagons chemical than it could be taken one mile on a dut road to a railroad station, unloaded, put on the cars, and carried to its destination."

"MOUNTAINS OF THE MOON"—"The geographical discoveries made by Mr. H. M. Stanley's septidition in its route, accompanied by Emm Pasha, to the south of Lake Albert Nyanza (sac) and weat of victors Nyanza, through a region previously unexplored, are the latest additions to our knowledge of the wonderful interior of what has been called the 'Dark Continent'. He ... describes the Ruventor range of mountains, rising above the Semilit valley and he considers them identical with what the ancients called



The Monatana of the Moon? The scenery afforded by these mountains, as on passes by their feet, is most spiended. Deep valleys of an intense darkness run up from the forest beneath A distinguishing feature, of the range is the clear and well defined character of the hill tops. Almost invariably on the southern side there are of a conical shape, with extremely steep slopes, some of them being quitt. 45 deg in steepness. In some places the ranne down which streams flow are quite 6000 or 7000 feet down the stream flow are quite 6000 or 7000 feet down the show the show the side of the places of the places of the places of the range is about 17,000 feet, with about 2000 feet above the snow line?

RABBITS—"A good deal of interest is being contered in the colorsal efforts made by the Victorian government for the suppression of the rabbit pest in that colors. In upward of 100 shires in the northern and western districts of the colory, simultaneous action is to be taken for the destruction of the rabbits, in accordance with the flabbit Suppression Act, reentily adopted by the Legislature Poisoned grain is to be largely used, and it is estimated that fully 75 per cent of the rabbits. Will be killed."

AT NIGHT "At a recent test of search lights for the purpose of discovering an approaching enemy dressed in uniforms of various colors, it was found that the red uniforms were very distinct, blue heing the least conspicuous."

BLIND—"Rev W. H Murray, a missionary at Peking, has devised a system for teaching the blind, and has reduced the Chinese language to 408 syllables. By this system the blind have been enabled

to learn to read with marvelous facility. The blind themselves are employed in the seterotyping and printing of books, which are produced at an amazingly low rate, compared with books embosed for the blind in this country. Among the Chinese the blind are regarded with great consideration, and they are watched with intense interest when they read with their fingers from the books which they carry in their hands?

FLOOD CONTROL. "Recent tourists in China announce that have entirely raise above supersition, abuse entirely raise above supersition, abuse that the Chinese merchants space contemptiously of the efforts of the priests to prevent the calamity of floods, saying, Chinanuan, he all time chin, 'uncaning that they recort to prayers and other priestly methods in time of calamity), 'while Melican man he build more stood walls to keep water back."

LIGHT..."The light of the firefly is not a vital, but a chemical process. It seems that chemistry should find means to initiate this process, giving us a form of combustion wherein the energy of field is all converted into light instead of being mostly wasted in heat?

RALEOAD SIGNALS—"The block system of running rational trains. has executly been introduced upon the Central Rational four track road, and is traversed by a very large number of transidabl. It has been found advanable to protect all classes of traffic and accordingly the system has been put in operation on the four tracks. The signals are semaphores, and are arranged one above the other for a single line of track. The upper enable has a signare out, the lower semaphore has a future of the been simple tracks in the signal are arranged one above the other for a single line of track. The upper enablore has a future of the been signal as a future of the been signal at a train is on the next block. Whenever it projects in this way, the block thus protected the inpre- signal falls, but the fish-tail signal remains at cention until the next block is passed and the train is too block distant."

BILLS—"All of the bank note currency of the Italian government is engraved and printed in the United States."

TWENTY MULES?—"There are five teams engaged in hauling borax from the works in Saline Valley to the railroad. In this newly discovered borax field lies the greatest natural deposit of borax now known to exist in any part of the world. It is only necessary to dig up the mineral and shove it into vagooit in tho vagooit.

AND NOW FOR THE FUTURE

- ¶ What is the place of blimps in modern warfare? By Brockholst Livingston.
- ¶ Archeological discoveries in an Anglo-Saxon treasure ship By J. Reid Moir, F.R.S.
- ¶ New radio relay holds possibilities for networking television programs
- ¶ The secret of immortality for living tissue. By Barclay Moon Newman.
- ¶ Industry makes good business out of the bad business of illness By John F. McMahon.



(Q) enough for the job

We live in a big country and it takes a big telephone company to give good service to millions of people. The Bell System is doing its part in providing for the nation's telephone needs, whatever they may be.

But the Bell System aims to be big in more ways than mere size. It aims to be big in the conduct of its business, in its relations with employees and its plans for the future. All of this helps to give the nation quick, dependable, courteous telephone service at low cost.





AIR CONTROL SOLVES TUBE PROBLEM

CATHODE - RAY tubes, widely used in research laboratories and industrial applications, are sometimes temperamental The reduced air pressure within them must be exactly right or they will not operate satisfactorily This factor has been overcome by mechanical methods in the past, but only with partial satisfaction. When Westinghouse engineers were working on a new cathode-ray oscillograph (shown at left) for use in the new highvoltage laboratory of the Bureau of Standards. they incorporated in it a small bellows by means of which the number of air molecules within the tube could be accurately controlled, thus doing away with the formerly used mechanical devices. The new oscillograph will be used to measure high voltages in research on the effectiveness of electrical insulation and lightning arresters.



Every bunch of bananas is dunked at the shipping point to destroy all clinging pests such as insects

GREEN DRAGON OF THE TROPICS

THANKS to Hollywood, most of us think of bananas as the easy mana of the drowsy tropics. A recent movie depicted the hero lounging around the tropics and reaching up to pluck mellow, ripe fruit from the trees In real life and in real tropics, bananas don't ripen edibly on the plant They have to be out green and left to ripen in the shade If they ripen on the plant the pods split and the pulp sour.

Indeed the banana is one of the most deheate and scrupulously cultivated crops on earth. Every stage requires hard work and tender care. The banana slos requires perpetual haste, an average initial investment of about \$400 per banana acre, and more man-hours of labor than any other principal harvest of the modern world.

In bananas, every dime must be earned with hard work, sally sweat, and fast motion. That is why the banana-growing republics of Guatemala. Honduras. Costa Rica, and Panama are becoming elysiums of employment, why banana-growing centers frequently have more iobs than men to fill them. Ma.

Banana Fungus, Picturesquely Named by Natives, Threatened Extinction of Industry . . . Menace Averted . . . Enormous Cost, Ingenuity Involved

By CHARLES MORROW WILSON

chines are said to rob men of jobs. The hannan industry fieldy denies this, During the past ten years the tonnage of banana machinery has been almost doubled So has the number of banana jobs. Every two acress of the crop now means a year-around job, and approximately every five tons of new banana machinery seems to create a new banana job.

AND to the normal hazards of flood, drought, and hurricane there has been added of late a further and more terrifying threat to this 300,000,000-dollar-per-year industry the sinister disease known as Sigatoka. A leaf-killing fungus apread by a wind-blows spore, this disease has played havoc in

vast sections of the republics to the south, threatening to obliterate the en tire banana crop there as it has already done in the South Seas

It is no longer enough that banana men work for a living, Now they have to fight for it—not with firearms or revolutions, but with spray guns, dust-throwing airplanes, and spray-aquiring tractors Banana-land's new war is a fight to the death against this mysterious leaf-killing fungus, scientifically known as Cercospora musace timm

Sigatoka takes its common name from the region where it first appeared—the banana-growing center of the Fip Islands. Until the disease struck there, that region was one of the great bananagrowing areas of the world The tmy



Using the pipe-line type of spray against the fungus Sigatoka in Honduras. The pipe-line "grid", with hose connections, runs all over a plantation

round spores of Sigatoka settle upon the broad lush banana leaves, and within two or three weeks multiply to form gray-brown "death-spots" These spread and grow until the leaf-trat uture of the plant is twisted and parched as though burned by fire. The fungus doesn't impair the food value of the fruit, but by killing the leaf surfaces it causes the fruit to ripen prematurely. Hence ha nana traders would buy geren-cut fruit which looked all right. They would load at aboard ships and entire banana car goes would ripen prematurely in mid-occus and rot before their reached nort

The method by which the diseasespread was as unsidious as its effects. Borne by the wind, it swept on at altitudes from sea level to 14,000 feet in the wettest jungles and direct deserts. One crew of alarmed pathologists took to the air At 5000 feet they held our glucose coated slides and caught live Signatoka spores on the glass.

NO wonder the discase has circled the banana production in Australia and New Zealand swept into South China Siam Malaysia, and various South Sea islands and out westward to India, the Canary Islands and the Guinea coast of Africa In 1935, Sigatoka blew into the western tropics. In 1936, the mysterious fungus began to invade tropical mainlands striking first in the renowned Ulua basin of Honduras Within a year, about 80 percent, or some 32,000 acres of the champion Honduran crop was reported infested and the "Green Dragon," as the natives call the disease, was charg ing forward into Cuba, Jamaica, and other West Indian islands.

Obviously something had to be Sigatoka was threatening the life of the American banana industry with its more than a half billion dollars of United States capital We can't raise bananas commercially in the United States But we eat about 10 billion bananas a year Their catoric value is high, we absorb from them 460 calories per pound (neeled) and more vitamins than from any domestic fruit. berry, or melon The banana has, therefore been called the poor man's food fruit Current mednal literature stresses bananas as infant food, a counter-actant for constitution and as a hospital standby for the aged and infirm A widespread shortage of bananas would seriously affect our national diet

As the Signtoka menace grew it began to threaten international trade as well. For the banana is the one great American crop whose ex port volume is steadily growing Warinfested England and Europe still import nearly 40 million bunches a year. Western bananas have "taken over" English markets, made rapid inroads into continental Europe and Scandinavia and reached the markets of Spitzbergen, 300 miles north of the Arctic Circle Hitler lists American-grown bananas as "indispensable food" and, until the outbreak of the present war, had bartered for import of more than 15 million stems per year Last year watched the first shipload of Colombian bananas leave for Soviet Russia. Three weeks later, I read dispatches stating that a "novel

delicacy called bananas" were being sold in Moscow at 35 cents apiece—thus yielding the U. S. S. R. a net profit of about 1500 percent! United States dealers have no such lofty ideals of profits for they gladly take a net profit on bananas of 1 to 5 percent.

But it is in South America that the banana is most needed. The lives of five republics down there depend upon ba nanas, which are their surest tax source the basis of a 50 million-dollar-a-year cash payroll, the sustainer of at least 125 ocean ships and about 2500 miles of necessary railroads. In Central America bananas build roads, bridges, and drain age systems From Guatemala through Colombia, more than 400 common schools are maintained by banana plant ers and companies. United Fruit, alone maintains 11 base hospitals from Cuba to Colombia, which give medical services and hospitalization to more than 200,000 patients each year Malaria, scourge of the tropics, has been pretty well beaten back from the American banana front



Tractor-drawn spray tank. Many noszles shoot the liquid fungicide in all directions

Without bananas, it would probably come back and this largest battlefront against tropical disease would timble

Green bananas are a basic food in the tropics. Fed to livestock, they are grass and grain together, since the starch and minerals of unripe bananas are like those of grain. Plantains, or cooking bananas, are a staple fare for people Green bananas they mash into dough for pan bread or they bake or fry them.

Moreover, the banana industry hahoisted tropical wage levels and bari shed peonage as it changed thousandof native workers, schooled only in use of the machete, to skilled workers who now qualify for more than 200 tradeThese newly skilled workers, many of whom earn as much in a day as their fathers earned in a week, couldn't be expected to return willingly to dried beans and jungle joblessness If neglected, the spore of Sigatoka could very easily become the spore of Pan-American change.

But Sigatoka is not being neglected Four years ago when the roundsporer fungus made its dumbfounding appears ance, native witch doctors arise vapor-to-usly to peddle alleged cures, includings of the mysterious buguets to be injected with the some planters chopped down their based and poddermic needle into banana stems. Some planters chopped down their based in the vain hope that the running spores would not come again others pool-pooled the menace and of the struggled to keep no with old rotutines. United Fruit, which owns and operates about 110,000 acres of binana lands, do ares of binana lands,

armored itself with a huge catalog of fungicides and set out as corporate knight to slav the ruinous Green Monster

After four years of dramatic but bloodless jousting, Sigatoka is by way of being licked, but not without colossal work head aches and expense

EARLY experiments rivatives check the spread of the fungus The chief task was to devise a practical means for getting a spray to stick to the leafy plant in heavy rainfall ch mates United Fruit staged a ten-nation brain storm in which engineers, scientists, accountants, and fruit cut ters turned inventors overnight The new principle of the griddle-type pipeline spray came into being Ba nana fields are grouped into spray units of 600 to 1200 acres For each unit must

be built a central pumping and mixing plant, equipped with a reservoir and a block of Diesel-driven pumps, which mix the spray and force it into the pipe-lines at high pressures. The pipelines are equipped with hose cocks at convenient intervals of from 120 to 200 feet. Actual spraying is done with garden-type hoses topped with high-pressure "nozzle guins" which break the liquid spray into fine mix and hurl it over the entire leaf surface of the giant permanent spray equipment requires a thousand or more pounds of metal pipe per acre.

In addition to this permanent installation, two-man spray crews make the rounds of banana fields at intervals of 10, 15, or 30 days, depending upon the





Conveyors carry bananss aboard ship and into the hold, above and at left. Since bananss must be handled with tender care, each bunch rests in a flexible canvas pocket

virulence of Sigatoka, spraying every plant with Bordeaux mixture which con sasts of five pounds each of copper sulfate and hydrated lime to each 50 gallons of water The men cover about five acresper day between dawn and noon, the preferred tropical working hours: A commanding majority of all banana growers throughout the American tropics are becoming "spray conscious." Tractor sprays are taking to dyland banana fields of Jamacca and Colombia Small growers on banana outskirts are fighting the Green Dragon with squirt guns and back-pack sprayers

At present, about 90,000 acres of United Fruit Company lands are under spray, and the acreage is rapidly being extended Before the ground spray net works were completed, the company opened Sigatoka warfare in the air, using a squadion of especially built dusting planes which set a world record by dusting 208,000 acres with 8200 tons of lime-sulfur powder in 2152 flying bours without a fatality or major crackup

However, plane dusting is less effective than liquid spray and is gradually being discontinued Meanwhile Sigatoka mysteries remain It appears, for example, that the roundspore does not verrously molest banana plants which grow in shade Nobody can explain this But coffee-banana farmers, particularly of highland Gustemalla, are

taking advantage of it to grow bananas under shade trees used to shelter the delicate coffee bush Unfortunately, shade impairs banana yields.

But Sigatoka defenses are holding in sprayed fields, banna leaves no longer writhe and twist with coalescing death spots. New style human plantings are being "put under spray" at worshead cost too great to allow the former practice of carefree abandonment to the ommpotent jungle Nowa days profitable bannas must stay in bearing from 10 to 25 years, instead of five years which was once the average bearing periods.

Banana planters continue to clear jungles, moving plantings farther and farther inland to tap new, rich, frontier



Part of the extensive mechanization in the war against Sigatokaa modern type of pumping station for banama spraying. Below Like gigantic lawn sprayers, water-rotated nousles throw fremen's streams over the baman plants. Each nonman plants. Each nonplies two inches of 'rainfall' every 24 hours for irrigation

All photographs by the author

soils In Guatemala. Costa Rica, and Panama, new banana operations are crossing the high backbone of mountains. New banana railways crowd through primeval wilderness.

From Mexico to the Guianas, Sigatoka dumbire speeds the banana tempo and more investment and invention. One of the newest of these is banana irrigation, the most elaborate known to any big-scale agriculture. The newest style banana irrigation, introduced in Honduras and Guatemala, consists of linked series of 25-foot metal



To prevent dropping bunches during harvesting, plant trunk is cut

towers fed by grant Diesel-powered pumps Each tower is topped by a water rotated nozzle which throws a firehydrant spray over three and a third acres of planting for the equivalent of two inches of rainfall every 24 hours

Cultivation and harvest methods are correspondingly improved, another important reason why the tropical Americas have become the commercial banana sources of the world, even though the real homeland of the fruit is India, 14, 000 miles away, and even though the name "banana" is a dialectic from the Guinea coast of Africa.

TTS an ill wind that blows no good Ill winds carrying Sigatoka sporrescontinue to blow damage and ruin to blow damage and ruin to outlying and unprotected bannal lands But the principal crop is being awed—and the fight against the disease has brought its benefits Banana employment as the sense of the percent, and the increased between 25 and 40 percent, and the increased between 25 and 40 percent, and the increased between 25 and 40 percent, and the increased between 55 and 40 percent set outliness of 50 percent set of the 50 percent set of 50 pe

Almost half of all market bananas are still grown by "independents," native farmers with limited acreage. These havbeen particularly hard hit. To help thesesmall farmers. United Fruit installs the newtype pupeline spray equipment upon the land and provides necessary services without taking the property in hock. The owner contracts to sell market-grade bananas to the company for a period of ten years at producer's prices common to the area. The company agrees to pay



cash for all fruit purchased and assures the grower a market for his entire production the year around, regardless of market conditions Spray systems are being installed in units averaging about 880 acres, with spray lines crossing boundaries of private farms.

Science, too, has had its wits tested in this battle. At present the conquest of Sigatoka appears to be man's most spectacular vectory over a crop-destroying fungus. To make the victory stack will require unceasang vigilance, but in that vigilance as well as in the conquest, science will learn new strategies. These strategies will stand us in good stead later, for fungi, not insects, may yet prove the chief enemy of man.

OUR POINT OF VIEW

Co-Operation

SO vast is the sea and so great are the numbers of food fish in it that any attempt to conserve the supply for the future may seem, at first glance, like carrying coals to Newcastle But the facts point the other way One particular species of salt-water fish - the striped bass - is rapidly approaching extinction, and what can happen to one species can conceivably happen to another. And if the "striper" of our eastern coastal waters can be preserved by co-operative application of the science of conservation, the same can be done for other species when the need arises

The striper is a fish that is of tremendous interest to both commercial and sport fishermen. Even when caught by the commercial fishermen in small quantities, the high price that the striper commands makes it rather worthwhile prey To the sport fisherman, whose numbers are increasing by leaps and bounds the striper is considered to be the king of surf and bay fish. The commercial fisherman contends that he has an malienable right to net and trap these fish wherever found. The sport fisherman claims an equal right to the fish and to the

beach along which the fish travel

Here is where the need for more knowledge and co-operation comes into the picture. Little is known of the life and habits of the striper, although several groups are now engaged in studying them and data are slowly piling up. When more is known about these things, everyone concerned will be in a better position to determine future policy and procedure. In the meantime sport fishermen of several eastern states are pressing legislation to protect the striper from the commercial fisherman, and the latter is just as active on the defense

To this writer, it seems that the greatest need at the moment is two-fold co-operation; co-operation between the legislative bodies of the various states in whose waters the striper is found, and between the sport and commercial fishermen Greed on the part of either or both of these groups should not be permitted to cause the striper to go the way of the buffalo. the heath hen, and the passenger pigeon. The science of conservation has progressed sufficiently to enable us to show what steps should be taken. Protection of the species is a positive necessity if it is to be preserved. Let us hope that this prize fish, so eagerly sought after by those who go down to the sea for sport, will not become extinct while the battle rages. Rather put severe restrictions on all fishermen first and then iron out the difficulties later, making readjustments as found necessary. At least this would preserve one of our natural heritages from extinction until tempers cool and the way is opened for satisfactory co-operation -A P. P.

Arms Against War

MANY attempts have been made to explain the present stalemate in the war between the Allies and Nazi Germany. No longer do people call it a phoney war; some, indeed, see in it a ray of hope for the future, a hope that the terrible bloodshed of 1914-1918 may never be repeated.

All wars are waged to wear down the enemy. To do this in the present war, each side thinks to starve the other out. Both know the futility of attacking along the French-German line, for both understand that the attacker would suffer enormously higher losses than the defender. There remain the sea and air. War on and under the sea has been put under control. The air, however, still has its menace. Aircraft are feared, not because they kill many civilians but for the deadly gas they can carry and because of their potentialities for the destruction of property. Small squadrons of planes have been active, but so far there have been no waves of hundreds of planes over enemy cities as was threatened. Why? Fear of reprisals? Britain evidently leans toward this theory if we can judge by an editorial in The Engineer (London)

In discussing safety measures taken in the British Isles to assure low casualty rates in case of air raids, The Engineer states "It is impossible to estimate how many millions of pounds have been spent in this country on these air-raid precautions, and up to the moment of writing, it can only be said of them that by their mere existence they may have averted attack Dread of reprisals is the most effective A. R. P. of all." We have confirmation of this dread of reprisals in Hitler's own words, the substance of which was that Germany had a weapon which could not be used against Germany In making such a statement, he knew what all belligerents know, that, despite a certain difference in quantity of arms, the theme of this war is quid pro quo.

One further thought from The Engineer: "It would seem that man finds himself in possession of a weapon so terrible that he dare not use it save against the defenseless." In speaking thus of the deadliness of aircraft, The Engineer approaches closely to a thought we have held for months. It has been our feeling that the very deadliness and enormity of modern armaments have done more than all the cries of horror by the pacifists during the past decades, if not to stop war, at least to limit rigidly the bloodshed of a modern war between powerful nations. While the burden of armaments is a heavy load for populations to bear in peace times, it seems to us that this war may yet prove that it is the armaments themselves which have more effect than common disarmament which renders a country defenseless. It may follow from this that all peoples may see the utter futility of armed warfare. between equals, in the future and devote their energies solely toward the sort of economic warfare which is being waged today -- F D. M

Printing's Semi-Millenium

 $F^{
m IVE}$ hundred years ago, if we can agree on the date, 1440, that has long been accepted, Johannes Gutenberg invented movable type. In the last five words of that sentence, there is basis for volumes of philosophizing

Prior to Gutenberg's achievement, some thousands (or tens of thousands) of scribes laboriously made copies of books by hand Consequently, books were costly and could be owned by few, the learning of the ages was passed on largely by lectures; and culture was a plant of extremely slow growth.

Following Gutenberg, civilization's processes were speeded up and the world passed through its most amazing 500 years of progress Today a book which only a king could buy before Gutenberg, can be bought by any child out of his pocket money, and millions of people, from writers to compositors and pressmen to lumberjacks and paper makers to news dealers and truck drivers, have employment because of movable type. (Somewhere, too, the over-worked, much maligned. necessary evil called "editor" fits into that list)

Technically Gutenberg's accomplishment was "re-invention," for the Chinese invented and used movable type many centuries earlier. Yet we have no desire to subtract one iota of the honor due this "scion of a patrician family of Mains," as a recent bulletin from Germany proudly described him. His contribution to the broadening of culture, and therefore to the more rapid progress of civilization, is incalculable. It is unfortunate that war prevents the world from joining with Germany in her several celebrations this year to pay homage to this great and beneficent inventor. - O. D. M.

More Miles Per Gallon

IT is a virtual certainty that the auto mobile of the future will travel farther on a gallon of gasoline than the car of today In all lakelihood this gain, possibly as much as 50 percent, will come, not through any sensational discovery, but by following a path already well beaten—the continued correlated development of fuels and engines.

In the past, automotive engineers have taken advantage of constantly improving fuel quality by increasing the compression ratio with resultant increases in power per cubic inch of displacement and power per gallon of fuel The improvement of the anti-knock quality of gasohne is a necessary part of this correlated development because the tendency of fuel to knock limits the ability of the spark-ignition engine to convert the energy of fuel into power As this limiting factor has been removed permitting higher and higher compression ratios power and performance have improved The recent rise in the anti-knock quality of gasolines available to motorists indicates that this trend is continuing

Fuel of the Future . . . Car of Future Designed For It . . . Both Will Come Through Co-Operative Research . . . Future Presaged by Past Progress

By Dr. GRAHAM EDGAR

The possibilities of increased gasoline economy through developing this prin ciple still further have been amply demonstrated by ex haustive experiments Re search engineers using an automobile equipped with a valve-in-head engine as a test vehicle, conducted a series of tests in the laboratory and on the road at a number of compress on ratios and gear ratios Fuels in each case were just capable of avoiding knock - approximately 69 octane for 5.25 compression



Distribution of leaded gasoline has expanded enormously since first sold here in 1923

Part—just a small part—of the vast chemical industry that has been built up since 1923 to make tetraethyl lead for gasoline. This unit produces ethylene

ratio, 95 octane for 80 compression ratio, and something over 100 octane for 100 untain for 100

"Super-charging, generally applied so far only to aircraft, opens another field of opportunity for improved gasoline consistency of the property of the proper

Unquestionably one of the important industrial advances of this generation has been this correlated development of fuels and engines — a development that has changed our whole system of passen ger and freight transportation Out of it has grown a system of motor transportation unrivated anywhere in the world — bus and truck lines that stretch into every nook and corner of the nation, 25,000.000 private passenger cars, transcontinental, intercontinental, and transcontinental, intercontinental, and trans-



Parentle Aerial Surveys inc.

Bromine is extracted from the sea at this plant on Kure's Beach, North (arolina. Water from the Atlantic Ocean, not shown,
is pumped into the settling basin in the foreground, from which 200 million gallons a day flow into the processing plant.

oceanic air lines on regular schedules Behind this development has the col lective effort of dozens of research laboratories representing many industries. All have made important contributions to the general program of improve ment Not least among these contributions was that made by tetraethyl lead in breaking down the barrier of knock Tetraethyl lead was but one of the tributaries of the stream of progress, but, judged by any scale of values, it played an important role Many of the facts about it have become a matter of general knowledge, others are not so well known

Almost every motorist is familiar with the small white sign on gasoline service station pumps which reads "Contains Lead " Some are familiar with the story of the recognition of the problem of knock by Charles F Kettering of General Motors, with the long search by Thomas Midgley, Jr., and T A Boyd for a satisfactory anti-knock compound and the eventual discovery of tetraethyl lead. But few know of the obstacles that had to be overcome before this antiknock agent could be made available commercially; of the problem of raw materials, of manufacture, or the years of continuous research that were necessary to the utilization of the product after it was developed

Gasoline containing tetraethyl lead

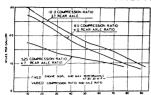
was first out on public sale at a single service station in Dayton Ohio on February 1 1923, under the now familiar name of "Ethyl" gasoline Immediate acceptance of the new product indicated that the ordinary fuel of that day was not satisfactory for even the low-com pression automotive engine of the time and the sale of Ethyl gasoline began to spread rapidly By 1931 12 percent of the entire gasoline consumption of the United States was Ethyl gasoline. sold at premium price. In April, 1933, oil companies began using tetraethyl lead in their regular-grade gasolines. Today, 75 percent of all gasoline sold in the United States and Canada contains tetraethyl lead. In the field of aviation, almost all gasoline of 80 octane number. or better, contains tetraethyl lead, in fact the performance of the modern military and transport plane is due, in large part, to the development of highoctane gasoline, a development in which this anti-knock compound played an important part.

Outside of the United States, tetraethyl lead is used in motor gasoline extensively in England, France, Australia, New Zealand, and Germany, and to a smaller extent in many other countries. In aircraft, for both military and transport purposes, it is used in nearly every country in the world.

But this success story could not be

told had it not been for the years of study and research on problems concern ing which the general public knows little or nothing Developing a product in the laboratory is one thing, manufacturing it in commercial quantities is quite an other. The manufacture of tetraethyllead has represented serious problems from the start There was no "prior art" in the large scale production of any organo-metallic compound, and knowl edge had to be accumulated by gradual and sometimes painful experience Three plants in succession were built, used for a time, and then abandoned before we learned to make tetraethal lead in substantially the way it is manufactured today

It was necessary, first of all, to solve the serious problem of adequate supplies of basic raw materials Tetraethyl lead is manufactured by the reaction of ethyl chloride with an alloy of sodium and metallic lead, and the immediate raw materials are therefore ethyl chloride. sodium, and lead With the exception of metallic lead, none of these are avail able commercially in the quantities required, and for this reason, as well as in the interest of manufacturing economy, it was necessary to produce them at our own plants. An accompanying diagram gives a flow sheet of the manufacturing operations. Salt is electrolyzed to produce sodium and chlorine



Increase the compression ratio of the car engine and the result is more miles per gallon at a wide range of car speeds

The sodium is melted with lead to form the alloy which, after grinding, is ready for the final reaction. The chlorine formed in the electrolysas is burned with hydrogen to form gaseous bydrochloric

Recently a plant has been completed for the manufacture of ethyl chloride. using the ethylene process -- the first commercial development of its kind. The plant is a model of manufacturing efficiency and economy, but it took years of study and work to develop this particular art to its present state. In the ethylene process, refinery stabilizer gases, consisting largely of propane, are cracked, and the cracked gases are fractionated at low temperatures to separate the ethylene formed. This is allowed to react with hydrochloric acid gas at low temperature in presence of a catalyst to produce ethyl chloride.

In addition to tetraethyl lead, the finished anti-knock fluid requires the addition of ethylene dibromide, ethylene dichloride, and dye. The latter two are purchased in the open market, but an adequate supply of ethylene dibromide at reasonable cost has represented a serious manufacturing problem for many years. In the early days of Ethyl, bromine was an expensive chemical and the supply limited. The young tetraethyl lead industry spent half a million dollars on a boat to "mine" that great reservoir of raw materials, the sea. The experi ment itself was not an unqualified success, but it proved that bromine could be recovered in quantities with the proper kind of plant, equipment, and location Subsequently, such a plant, the only one of its kind in the world, was built at Kure's Beach, near Wilmington, North Carolina, under the joint auspices of the Ethyl Gasoline Corporation and the Dow Chemical Company. Its present output exceeds three million pounds of bromine a month.

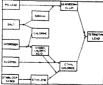
But the solution of these problems was only the beginning. Assured of an adequate supply of raw materials, the next step was chaustive tests of engines on dynamometer blocks and millions of miles on the road to determine the exact proportions of certain constituents of Ethyl fluid for most satisfactory results. This is a study which must go on end-leastly. Every new development in en-

gines and fuels calls for renewed effort to determine whether or not changes in design or operating conditions may indicate the desirability of changes in the composition of anti-knock fluid.

These are problems specific to tetraethyl lead. but "lead" is also a part of the tremendous and intricate problem of the internal combustion engine and its fuel When the full implications of the problem of knock were understood, the petroleum refiner set about to produce motor fuel of less and less tendency to detonate. The magic wrought by oil technologists in this connection is a matter of record. Cracking has been developed from what was originally merely a method of obtaining more gasoline from a barrel of crude oil to a method of changing the chemical structure of hydrocarbons. To the fundamen tal tools of temperature and pressure has been added the valuable instrument of catalysis

The anti-knock quality of fuels is of vital importance to automotive and air. craft engineers. They must keep in formed regarding the fuels that are available, and that soon may be available, and must design their engines to utilize these fuels as efficiently as may be practicable. They have other problems peculiar to their particular craft With every increase in compression ratio, with every few pounds additional in brake-mean-effective-pressure, a host of problems present themselves. New materials and improved design may be needed Difficult lubrication problems may arise

In addition to the problems peculiar to each of these great industries, there are others that require the joint efforts

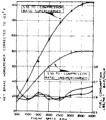


Flow chart of tetraethyl lead manufacture, showing chemicals needed

of both. Methods of measuring the knocking tendency of fuels, methods of expressing those measurements and the interpretation of the results, call for co-operative work by the technical staffs of the petroleum and automotive

The Ethyl Gasolme Corporation is directly of neutre the petroleum industry nor the automotive industry, but it is a child of both; and as such, it is the sensible to participate in many of its deserble opments outlined above. Its constraints are also as a constraint of the constraints of the const

It cannot be said that any of these developments have been due to a feeling of pure altruism on the part of any member of either industry They are the natural result of the American competitive system, and their net result is that the public today has vasily better fuels



Brake horsepower and fuel consumption with and without supercharging in engines under tests

and vastly better automobiles, trucks, busses, tractors, and airplanes than it had ten years ago

But what of the future" Will antiknock compounds continue to play the same important role in the correlated development of engines and fuels in the future as they have in the past? No one would be rash enough to predict the exact trends which may develop in the future, but enough data exist to show that a number of ways exist in which fuel of very high anti-knock value may be efficiently utilized.

What that fuel will be, no one can say, Constant progress in the refining art is increasing both the yield and quality of assoline. But wherever it is more economical to obtain any given octate level by the use of antiknock compounds, they will continue to be used and they will be added to the best available refinery product to produce the "fuel of the future" for which the automobile of the future will be developed.

WHAT DOES THE SOIL NEED?

Scientific Fertilizing Produces Remarkable Results
. . . Possible When Soil Minerals, Soil Needs Are
Known . . . Proper Tests Give Answer To Grower

By H. T. RUTLEDGE

In IVE-INCH rosebuds, daffodils the size of salad plates, snapdragons sw. feet tall -- such remarkable products of flower gardens are being reported by amateur and professional gardeners who are experimenting with the latest scentific methods of fertilizing Similar results are being achieved by some vegetable and fruit grovers

Often applications of commercial fertilizers bring spectacular results, while in other cases use of the same fertilizer may bring little or no benefit. The reason for this anomaly is easy to find when fundamentals are considered. In the first case, improvement is visible and may be extraordinary if the material supplied by the fertilizer is lacking in the soil In the second case, results will be negligible, or even non-existent, if the soil already has the materials which the fertilizer supplies, yet needs still others. The obvious conclusion is that the grower must first know the requirements of his soil, otherwise the fertilizer may be completely wasted

WHEN the grower does know his soil, he may begin scientific feet tizing. In theory, the problem of perfect fertizizing is complicated by the fact hat plant requirements are many, varied, and still partially unknown. In practice, it is greatly simplified because all but three of the important plant food elements are ordinarily bestowed without the aid of man. These three are easy to test for and easy to suinsly.

There remain some difficulties for the average gardener. Individual plants have different needs. The plant food content of the soil may vary widely within an area of a few square yards, and at different times of the growing season But a little study and systematic effort will show the way to a fertilizing program of maximum effectivenium effectivenium

The three plant food elements which the gardener must usually add to his soil are nitrogen, phosphorus, and potash. Until recently, most people were content to use some general fertilizer which, it is true, did contain certain amounts of each of these essentials But it would be partly luck if the gardener supplied the right food elements in the right amounts. He either wasted money by adding elements of which his plants already had enough, or he added too little of certain elements, and his garden suffered.

Hit-or-miss fertilizing usually meanfailure because there are so many important factors which it does not take into account. Drought and rainfall, sun and shade, affect the amounts of plant foods available in the soil Plants themselves are continually depleting the soil of its nutrients, and their needs vary

The amount and kind of fertilizer required depend on the condition of the soil at a certain time, in a certain place, and in relation to the needs of the plants that are being grown. By the use of simple but effective soil test kits, the gardener can determine for himself the degree to which his soil is deficient in nitrogen, phosphorus, and potash. The kits are easy to use, demanding only the ability to follow simple instructions and to compare colors accurately. With this information, the gardener can fertilize correctly—giving his plants the opti-

mum quantities of foods which they would otherwise lack. In view of the constant changes in soil conditions, best results are usually obtained by making periodic tests, and feeding frequently in rather small quantities. Larger applies thought the constant long intervals do not assure a regular diet of the foods that plants are using every day.

using every day.

The fertilizing is comparatively simple once the soil has been tested. If there are no unusual deficiencies, the gardener can otten use a complete fertilizer, esclecting a formula in accordance with his determined needs. When certain elements are very low special concentrated fertilizers may be used—either directly on the soil, or mixed with a 'complete' fertilizer material. Nitrogen may be furnished by pitrate of soid, ammonium sulfate, or calcium nitrate, phosphorus by superphosphate, treble superphosphate, or steamed bonemeal, and potasil by sulfate or muritate of potasil by superphosphate, treble superphosphate, profits muritate of soid, ammonium sulfate, or catemed bonemeal, and potasil by superphosphate.

The special needs of individual plants should also be considered in Jaying out a fertilizing program. It is important, in this connection, to remember that nitrogen contributes especially to the development of leaf and foliage; phosphorus to fruit and flowers; and potash to strong root growth. With identical soil conditions, a lawn requires more introgen in its fertilize; the flower garden, more phosphorus; and beets, carrots, radishes, and other root vegetables more potash.



With any soil testing kit, the tester uses but a spoonful of soil. Then, following simple instructions, he soon learns just what minerals his soil lacks—and needs

STARS THAT HAVE CHEMISTRIES

THE stars as a whole are very varied Some of them are a million times as bright as others, a thousand times as big, a hundred times as massive, and ten times as hot on the surface. Before we can study them satisfactorily, we must separate them into groups which are less excessively different from one another

The easiest way of doing this is to photograph their spectra. With a prism in front of a wide-angle lens, we can get many hundreds of legible records on one plate Most of them, as everyone knows, show line patterns of a few standard intergrading types Once in a while one used to come upon a queer one, unlike the general run, but as observation advanced, it became clear that these, too, belonged to classes of stars. similar among themselves, but less numerous than the main types At the present time, when hundreds of thousands of spectra have been examined. it would be hard to pick out a single one which is not at least fairly similar to a few others. Nature evidently has standard ways in which the stars may shine, very few in number compared with the multitude of the stars themselves

Among these less numerous groups are two closely related ones, denoted in catalogues by the letters N and R, and less technically, but more intelligibly referred to as the "carbon stars.

There is good reason for this name. Their spectra are cut to pieces by an enormous number of lines, grouped in many places into dense bands, which have long been known to be produced by carbon compounds. These have now been identified not as the ordinary molecules familiar in our laboratories, but as molecules partly, but not completely, decomposed into their elements at the high stellar temperature. So we have now CH -- with but one hydrogen atom remaining attached to the carbon - instead of the familiar CH, (methane), CA - not the cyanogen gas (C,N2) of the text-books, but a chemical "radical" so eager to combine with something that under ordinary conditions it combines with itself, and Cacarbon vapor ready to condense into a solid except at very high temperature or low pressure

In the red end of the spectrum, the lines are so crowded that they almost overlap. Here and there, a narrow clear space between them allows the normal "continuous" spectrum to show through With moderate or even fairly high, dispersive power these bright places look

Certain Classes of Stars Have Atmospheres Like the Familiar Oxidizing and Reducing Atmospheres of the Chemical Laboratory . . . Low Temperatures

By HENRY NORRIS RUSSELL, Ph.D. Chairman of the Department of Astronom, and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observators of the Carnegie Institution of Washington

just like emission lines. For years they were supposed to be due to some un-

identified luminous gas, until at last the detailed comparison of spectrograms taken with high dispersion with laboratory spectra revealed the truth

The presence of compounds - molecules - in obvious abundance would be proof by itself that these stars are cooler. on the surface than most others. This was realized first, however, because they are very red. The N stars, indeed, are much the reddest of all the important groups beginning about where the others leave off, with a color index of two magnitudes (that is, with about six times as much red light in comparison with violet as a star of standard color, like Vega) and running on to some which are 50 times as bright in the red as in the violet. The R stars are in all respects less extreme. They are not so red, the bands in their spectra are weaker, and those with the weakest bands grade naturally into familiar spectra of about Class K (Arcturus). They evidently represent cases in which all but a relatively small part of the compounds are dissociated by higher temperatures

THERE are other red stars in the THERE are other readment from the heavens (called Class M) and a few of them are as red as even the N stars, and these too have compounds in their atmospheres But these compounds are oxides Titanium oxide gives the strongest bands - and, in a few stars, zir conium oxide - but oxides of vanadium. scandium and attrium have recently been identified

It would be wrong to conclude that these unfamiliar metals are the most abundant in the stars. Their oxides happen to have strong bands in the smallish part of the spectrum which we can observe. Other metals, which do not, will he missed

But the fact that we find compounds of carbon in one sort of stars, and of oxygen in the other, is of great significance Here, indeed, we come to the point where we can speak of a real chemistry of the stars

The high-school laboratory student knows perfectly well the difference be tween an oxidizing and a reducing flame In the first, there are enough oxygen atoms to provide more oxygen than is necessary to combine with the hydro carbons of the gas supply, and the ex cess oxygen, at the high temperature, will act on any oxidizable substance on which the flame plays. In the second there is not enough oxygen to use up all the hydrocarbons, and the excess will take oxygen away from many metallic oxides, and leave the free metal

It was the late R. H. Curtiss, a dozen years or so ago, who first pointed out that in these two classes of stars, we have the familiar difference between an oxidizing and a reducing atmosphere With oxygen in excess, the carbon compounds are used up (being transformed into the more firmly bound carbon monoxide, which absorbs only in the far ultra violet) and the metallic oxides are left. With excess of carbon, the opposite happens

The oxygen stars of Class M are some thing like 100 times more numerous than the carbon stars of Classes N and R That is, we find about this proportion in our lists of stars down to the 7th or 8th magnitude Among the 6000 or so stars visible to the naked eye the fraction is even smaller. There are only about 20 of Class N, and but one of Class R and most of these are variable stars which rise above the 6th magnitude only at intervals

But it would not be safe to conclude that oxygen stars were actually far more abundant than carbon stars, in space until we knew at least the average real brightness of stars of the different classes Those of great luminosity can be seen at greater distances, and will get into our lists in disproportionate num

It is therefore of special interest to determine, if we can, the average dis tance and real brightness of the carbon

These objects are much too remote for direct measures of parallax by the trigonometric method, and to get a good average we must depend upon the comparison of proper motions and radial velocities The principle is simple. By the spectroscope we can find the rate of approach or recession of any star, in kilometers per second By comparing observations of right-ascension and declination (if we have good enough ones covering a long enough time) we can find how fast, in seconds of arc per year, the star appears to move across the heavens This last amount -- the proper motion -- depends both on the real velocity of the star, at right angles to our line of sight, and its distance. More precisely, it is proportional to the prodnot of the cross velocity by the parallax

For an individual star, this leaves us one the wiser, for the ratio of the components of vilority along and across the new for sight depends on the angle lee, tween the direction of motion and the new for sight the which may be anything a But when we can take the average for a considerable number of sight—six we can trust the laws of chance to give us pretty retails be salien.

AN apparent complication — but a real advantage — is introduced by the Sun's motion in space. If the stars themselves were at rest, this would cause them to appear to drift in the heavens toward the point away from which we were moving, and, knowing the speed of the Sun's motion and the angle at which its effects were foreshortened for a given star, we could calculate good parallaxes for each one. When the random motions of the stars are added to this, we must take, not the motion of an individual star in the drift-direction, but the aver age for a large number, and trust the individual motions (which are about as likely to be in one direction as opposite to it) to "average out" This will never happen exactly, but, for the average of 100 cases, it is an even chance that the outstanding effect will be not more than one tenth of the motion of an individual

We can get a quite independent determination of the mean parallax by taking and the proper motions of the stars at right, but an anglea to the direction of the drift. These selves, in a specified direction at right and the "pocular" velocities of the stars themsides, and a specified direction at right and the "pocular" velocities of the stars velocities of the stars leading to the line of sight, by we can subtracting from the observed velocity the effect of the Sun's motion, which can be very easily calculated.

We now take averages for the available stars—simply of the numerical values, disregarding the positive and negative signs—and trust that the mean will "average up" in the same way in one case as in the other. If there is no tendency for the real velocity of a star to be greater along the line of sight than

across it (which should be substantially the case for stars scattered all over the sky) we should get good average values — indeed it is found that the average result for 100 stars should be right within 7 percent half the time

This method was first applied to the N stars by Kapteyn, in 1910. The ma-



Propped up diagonally in this little museum on a public square in Corning, New York, the first of the two 200-inch glass mirror disks (the dightly imperfect one) 15 now available at all times, without a particle of previous formality or even an entrance fee, for all who wish to come there to inspect it. This is the mate to the largest piece of glass on earth, the one cast later and sent to California On a pinch it could even have been ground and polished and used in the telescope, and still could be so used in a tighter pinch However, because one of the 114 cores embodied in the mold for the purpose of leaving the disk ribbed or skeletonized at the back melted loose during the pouring of the molten glass and left solid glass in its place, it was decided to cast a new disk This was done in 1934 and that disk is now being prepared in Pasadena, California

terial then available was sufficient only to show that they were very distant, and among the brightest of all classes of stars

Thirty years of observations now provide enough material for a much more accurate value, and a thorough discuss soon has recently been published by Dr R. E. Wilson. There are now 106 stars of class N for which fairly good proper motions can be determined. Combining of these with the radial velocities (which have been observed for 145 stars) and using both the methods used thesussed. he finds that an average N star of mag nitude 7.3 has a parallax of 0".00166, which corresponds to a distance of 2000 light-years. The corresponding absolute magnitude is -1.6, which indicates a luminosity 300 times the Sun's Certain refinements of calculation raise this to nearly 400 times the Sun's light.

nearly 400 times inc. Sun a signit. These are therefore very luminous bodies. If we could measure the total energy radiated, including the invisible infra red. we would obtain much higher values—probably at least to times a great. The N stars are therefore game to the stars are therefore game to the purch difference on the small huminously between those in which the carbon bands are strongest and least heavy, but, as the former are probably cooler, the total energy radiated is probably greatest for the "latest types, as a game as to be among the N stars."

They are much brighter, by any stand and, than the average M star, so that our lists represent a hunt for them in a large volume of space, and they are still rarer than the first counts indicated

The R stars are fewer and fainter, and only 37 of them are available for discussion. For these, by similar methods, Dr. Wilson finds an absolute magnitude of -0.5, or about 120 times the Sun's visual luminosity.

O M third of the R stars, and four brightness Most of them vary irregularly and over a moderate range (not exceeding two magnitudes), though some are periodic, and a few have the large ranges characteristic of variables of class M

The physical conditions in these remarkable stars are still imperfectly un derstood. Unfortunately we have no way of getting at their masses, and finding to what degree they obey the general rule that bright stars are massive. Their surface temperatures must be among the lowest known, but are difficult to estimate, on account of the way in which the bands cut up the spectrum. Their diameters must therefore be very large. and gravity at their surfaces low. What keeps them shining is still a puzzle as for all the other giant stars, and how they came to differ in composition from the oxygen stars is a question which physics - even nuclear physics - is not in a position to inquire

One curious fact should still be men toned Not a single carbon star has been found among the hundred and more of red dwarfs which have so far been observed. Since there are probably at least 200 or 300 oxygen stars to one carbon star among the gunts in a given region of space, it may well be that we have not yet a sample of dwarf stars big enough to include one and it is premature to theorize about it—Mt. Wilson Observatory, January 29, 1960.

Man's Earthly Future

(In Two Parts - Part One) URING the first decade or two of the current century, geologists, astronomers, and physicists engaged in many discussions concerning the future of the Earth as an abode for life. Some believed that "the end of the world" was relatively close at hand; others that the prospect for the future was to be measured in terms of hundreds of thousands if not of millions of years As usual in scientific circles there has emerged from the conflict of ideas during the years of discussion a general unanimity of opinion, and today the geologic outlook for the future of the Earth is quite clear.

Since the turn of the century new methods of measuring the length of geologic time have been discovered and applied. New concepts of the nature and sources of energy have been proposed and tested New data concerning astronomic space and the distribution of the stars have been secured. Innumerable details of Earth history have been deciphered to give a trustworthy record of the changes which the Earth and its inhabitants have undergone in the past The key to unlock the secrets of the future is now available in this knowledge of the past, and with our present understanding of the processes of nature that key may be intelligently used. All the evidence combines to lead us unmistakably to the conclusion that for many scores if not for hundreds of millions of years to come the Earth will continue to be a comfortably habitable abode for creatures like ourselves

Surface temperatures of the Earth, the most important item in any consideration of its long-range habitability, are determined by the receipt of solar energy distributed through atmospheric agencies For any given area of land the annual contribution of heat from the Earth's interior, hot though it may be, is just about equal to the warmth received from the Sun in 20 minutes by an equal area in equatorial latitudes under a clear sky at mid-day The 19th Century picture of an Earth, initially fiery hot but progressively cooling so that yesterday it displayed a glacial climate and tomorrow it will be too frigid to support life, may now be thrown into the discard The Earth will "grow old and die" only as a result of failure to receive adequate supplies of radiant energy from the Sun The prospect that the Sun

From the Eighteenth Sigma Xi Lecture, delivered at the recent Columbus, Ohio convention of the American Association for the Advancement of How Long Will Our Earth Survive, and How Long Will the Species Called Man Endure on It? . . . Man's Fate: Either Oblivion or Improvement

By KIRTLEY F. MATHER

will "burn stelf out" in a decrept odd age as so remote as to haffle all attempts to date that untoward event even by the stellar of the stel

The lurid pictures of a sudden catastrophic debacle resulting from collision with some other heavenly body — comet, planet, star, or what you will— are products of a vivid imagination wholly without foundation in astronomic fact or theory.

THE only plausible alternative to the conclusion that Earth and Sun will continue the even tenor of their ways for an inconceivably long period of time is that the Sun will some day imitate the super-novae occasionally detected among the stars and terminate the existence of the entire solar system by a gigantic explosion Precisely one such super-nova has been observed within the galaxy of the Milky Way and several such in all the other galaxies of stars during the last few decades. The astronomers could therefore calculate for us the chances on a statistical basis that any individual star - the Sun, for example - would suffer such a fate within any given period of time. The result would be a figure so infinitesimal as to set at rest the mind of even the most littery of questioners. Pending the discovery of the kind of premonitory symptoms displayed by stars about to blow themselves to atoms. the best that can be done is to rest content in history. Since the earliest records of living creatures were left as fossils. if not indeed since the earliest sedimentary rocks were formed, the Sun has faithfully maintained its energy output within a fairly narrow range and has given no evidence of any fluctuations that might suggest any significant change in its behavior.

The geologist may therefore turn with confidence from the long perspective of geologic past with its one-and-a-half to two billion years of recorded Earth history to a similarly long prospect for the future. Time is one of the most overwhelming resources of our universe.

It should not be inferred, however. that the Earth will continue in the future to display the same environmental conditions as those which we enjoy today The history of mankind thus far has been enacted against a background that in the full perspective of Earth history is truly extraordinary The geologic period in which we live is a time of unusually rugged and extensive lands with notably varied climate ranging from the glacial cold of Greenland and Antarctica to the oppressive warmth and humidity of certain equatorial regions. Such conditions have apparently recurred many times at long-spaced intervals since the oldest known rocks were formed, but added together the time thus represented cannot be as much as a fourth of geologic time. Much more characteristic of Earth history as a whole have been the conditions illustrated by those periods when corals thrived in shallow seas occupying the site of Baffin Land and North Greenland. and coal-forming plants flourished on Antarctica The probability is strong that eventually, say in five or ten million years, the Earth will display again the physical conditions of many past geologic periods that were characterized by broad low lands, wide shallow seas, and uniform genial climate

But most of us have a greater interest in the next few centuries than in the subsequent millions of years Minor changes in chimate will doubtless occur just as they have in the last few thousand years Unfortunately, or perhaps fortunately, there is no basis for prediction concerning their nature, whether for better or for worse There is really no good reason for referring to the present as "a post-glacial epoch"; it may prove to be an interglacial epoch. But our ancestors weathered ice ages in the past and presumably we are better equipped for such contingencies than they were. Should the average annual temperature of the Earth as a whole be reduced something like 10 degrees, Fahrenheit, and

remain at that lower level for a few millenia, it is likely that once more the greater part of Canada, the northern United States, and the Scandinavian countries would be buried beneath great ice sheets. But in consequence of the removal of water from the sea as vapor to form the snow to produce the glacial ice, considerable areas now shallowly submerged along the coastlines in middle and equatorial latitudes would emerge as dry land. Indeed, it is likely that the area of land suitable for human abode would be nearly or quite as great at the climax of a glacial period as it is today

By the same token, the disappearance of existing bodies of glacial ice as a result of rapid amelioration of climate in the not-distant future would, if it occurred, be a decidedly mixed blessing Return to the sea the water now imprisoned in the ice on the Arctic islands, Greenland and Antarctica without any compensating changes in crustal eleva tion, and sea level would be raised 50 or 60 feet the world around Considering the number of people who now work or sleep in buildings in metropolitan com munities not over 50 feet above sea level. the importance of such a change is readily apparent.

But from the geologist's point of you these are relatively trivial matters. With due deference to the nature of the climatter with a geologic changes which are certain to occur in the next few thousand years, there is nothing to be expected from such sources that would seriously deter the human spectrom maintaining a comfortable existence on the surface of the Earth for an indefinitely long period of time—a period to be measured in millions rather than m mere thousands of years.

AT last, it is generally understood that man is a part of nature. Hit may be something more than an animal (that depends largely upon definition), but he is none the least truly a part of the animal world. Like the other inhabitant of the Earth, man is a product of evolutionary processes operating on this particular planet.

We may be the last products of the creative forces displaying themselves in the organic development taking place in this particular portion of the cosmos, but we have no reason to assume that we are the last achievement of those forces. Nor does the fact that man has arisen from a lowly origin through processes of evolution validate the optimistic inference that he will necessarily continue his progress to ever higher levels of activity. Evolution does not guarantee progress, it merely guarantees change. The change may be for the better or the worse, depending upon the conditions of time and place and the vitality of the individuals concerned.

The pages of Mother Earth's dary reveal an amazing and thought-prooksing record of the progress of living creatures throughout the long eras of Earth history Again and agam, in the procession of the living, dynasties of anmals or plants have arisen from a humble origin to a position of world supremacy, maintained for a comparatively herel period and then lost forever



Drawing the teeth of environment, in modern structures such as that if lifth Avenue, New York, building of the Corning Glass Works), man, more now than ever liefore, is in near control of his environment. Here little pieces of an always comfortable world that does not often exist outside are created artificially. Man is the only animal which has been able to do this

Some have disappeared entirely as their paths have led them off into blind alleys paths have led them off into blind alleys of their paths have sunk to a low level and have continued a degenerate evistence to the present day. A few have given rise to sther and more efficient forms of life which superseded their predecessors as their and more efficient forms of the success and faulties when the superseded their predecessors as received in the superseded their predecessors as success and faulties and the success and faulties and the superseded their predecessors of the past, if he uses the methectual and moral resources when he are subtilied to the superseded their predecessors of the past, if he uses whether are suitable for him.

From the point of view attained through knowledge of geologic life development, man has toddy a unique opportunity to gain continuing security for himself and his progeny on the face of the Earth, but whether or not he takes advantage of hat opportunity is to be determined largely by himself. So far as we can tell, man is the first animal possessing the power to determine his own evolutionary destiny, but there is nothing in the record which guarantees that he will use that power wisely,

The animal species that in the past have been able to maintain their existence for more than two or three million years are relatively few in number. Most

of them were comparatively simple types belonging to the less highly organized branches or phyla of the animal kingdom Many were inhabitants of the sea where environmental conditions were remarkably stable throughout long periods of time Among placental mammals, the major subdivision of the vertebrates to which man belongs, there is no similar record of longevity Except under extraordinary conditions of geographic isolation, no species of placental mammal has persisted more than two or three million years No matter how successful it may have been temporarily in multiplying and sproading over the face of the Earth, each has become extinct in a geologically brief span of time. Perhaps a half million years might appropriately be taken as the average "life" of a species in this group of highly organized and notably complex creatures

BUT extinction does not necessarily mean failure, it has frequently indicated the acme of achievement. For example, some of the now extinct three-tord horses and four tord camels passed on "the torch of progress" to their descendants the one tord horses and two-tord camels, and thus gained long-continuous security for their kind.

What then does the future hold for sisted of three of forms Homo has already existed for three of four hundred thousand years, the species Homo superis has about 50 000 coars to its credit if the average applies, we may expect nearly or quite a half million years more of existence for our kind and then either oblivious as we reach the end of a blind alley or progressive development into some type of desendant better adjusted than we to the total environmental factors of the time.

But does the average apply? Must man exit from the seene through either of the doors, that which closed behind the dinosaurs and titanotheres or that which opened before the three-toed horses and notharctines?

Most creatures having anned security by specializing in adjustment of strucmental minimum and a security of a mental minimum and a security of a culture of a security of a structure, and habits to a variety of extraorments. No other vertebrate can live as can be on Antarctic sec cap, in Amazonian jungle, beneath the surface of the sea or high in the surface of the sea or high in the surface of the sea or high

Furthermore, man is the world's foremost specialist in transforming environments to bring them within the range of his powers. Far more efficient than the beaver or the mound-building ant, he drains the swamp, irrigates the desert, tunnels the mountain, bridges the river, digs the canal, conditions the air in home, factory and office.

As a matter of fact, adjustability to environment is accomplished more by

controlling surroundings than by modifying internal organs or essential functions of the body. When we ascend with Major Stevens into the stratosphere, or dive with Doctor Beebe 500 fathoms deep off Bermuda, or live with Admiral Byrd through the long night of Little America, we take along with us a sample of sea-level atmosphere and temperate climate which is our real environment in a situation otherwise unbearable. Fur lined parkes and tropical linen suits are but a medium for ensuring an immediate environment as nearly as possible like that of middle latitudes when living in polar or equatorial surroundings

But, regardless of interpretation of procedure, the result is clear Man has placed himself in control of external conditions to an extent immeasurably greater than has any other creature. He has practically "drawn the teeth" of enveronments.

ACTIOUGH we know tutle of the details at sectain that most of the creatures of the past who "have had their day and ceased to be" were forced into extinction by changes of one surt or an other in their environment, changes which came with such relative speed that they were unable to make adjustment to them in time. Main need have no fear on that score.

It is, however immediately apparent hat man's conquest of his surroundinghas resulted from his clever use of things. Unless there is caseless flow of cotton, flax and wool, of coal, iron and petroleum, of copper, lead and tin, from ground to processing plant to consumer, he becomes a puny weaking. It is because he uses certain resources provided by his environment that he is freed from slavery to his environment. Are these resources adequate to keep him supplied with what he needs to maintain indefinitely the sort of existence to which he has accustomed himself?

There are two fundamental sources of the goods and the energy which man uses in the grim business of securing the sort of living which he apparently desires. On the one hand there is the farm and the waterfall on the other there is the mine and the quarry. Things which grow in the field or forest, and power produced by falling water are in the category of annual income Now that scientific research has made available the limitless quantity of navogen in the air for use as fertilizer, the resources of the plant and animal kingdoms are renewable, we use them, but we need never use them up. In startling contrast the resources of the mineral kingdom are non-renewable, they are in the category of accumulated capital. Petroleum and coal, copper and iron, lead and vana dium, these and many other prerequi sites of modern civilization have been accumulated by nature through hun

dreds of millions of years of geologic activity. Thanks to scientific research, and is exhausing that store of mineral wealth in a few hundred, or at most a few thousand years. That inexcapable fact is at rock bottom one of the most fundamental causes of economic distress, of war between nations, and of strife between classes.

Fairly accurate estimates of the world



ourtesy National Petroleum Neu

Photographs like this showing oil wells aftre and wasting thousands of barrels of oil, will be due out three generations bence, from the musty files of the magazines of 1940 and reproduced again, so that posterity to whom we shall transmit but a meager supply of petroleum. may curse our produgality in recklessly wasting a resource which we know to be non-renewable. Oninions differ widely Some simply remark, "Why worry?" and quote that shoowern wiserrack did posterity ever do for us?" True we may learn to get heat direct from the Sun, lubricants from other sources than petroleum, energy from the atom, but are we sure?

stores of many non renewable resources are now available. Take petroleum as an illustration. The known available reserves of petroleum beneath the surface of the United States total at present ap proximately 17 billion barrels' Experts differ in their guesses as to the quantity of putralaum that may be discovered in the future in areas that have not yet been adequately explored with the drill or in known fields by discovery of deeper reservous not yet reached by the deenest wells in those fields. There are also many varying shades of optimism and pessimism concerning the possibility of increasing materially the percentage of

recovery of the oil present in a reservoir rock when penetrated by drilling operations. Estimates of the quantity to be added to our petroleum reserves from these two sources range from seven or eight billion barrels to 15 or 20 billion. I would incline toward the larger figures considering them as maxima which are extremely unlikely to be exceeded. On that basis, the present store of available petroleum beneath the surface of the United States is 25 to 35 billion barrels That is only about 30 times the annual domestic consumption of petroleum in recent years. The average annual production of petroleum in the United States during the five years from 1934 through 1938 was almost 1.100,000,000 barrels. and the 1939 production exceeds 1,250. 000,000 barrels. At the present rate of withdrawal, the domestic stores of this essential raw material would therefore he exhausted in less than a third of a control

DATA are not nearly so precise for for the United States. It is, however, fairly, safe to conclude that the world stores of petroleum will last only some to withdrawal. With the possible except of withdrawal. With the possible except to not of Mexico, no other country has been as successful as the United States of the petroleum will be the store of the s

Lest we become too pessimistic in response to such unwelcome figures, we should promptly note that substitutes for petroleum are already known Gasoline. fuel oil and lubricating oil can now be manufactured from coal and other rocks rich in carbon, by processes of hydrogenation and polymerization. These are expensive processes and their products cannot now compete with the products from petroleum even in countries far removed, both geographically and psychologically, from the more productive oil fields' They will, however, come into use more and more in the next few decades

Enough bituminous and sub-bituminous coal's known to be available within the United States to meet the present annual demand for coal, plus enough to manufacture gaseline and feel oil in aid forest quantity to meet current demands for at least 2000 years. In addition there is enough of balles— rock rich in accident to the continuous properties of the continuous properties of the continuous properties of the continuous properties of the continuous properties. The continuous properties are continuous properties and the continuous properties are continuous properties.

(To be Concluded)

7 Statistics from "Minerals Yearbook," published annually by the United States Bureau of Mines 4 E. O. Reald, "Technology and the Mineral Industries, WPA National Research Project, Report E-1, pp. 27-31 1837

[&]quot;Petroleum Reserves Are Estimated by Institute Committee at New Record Total," American Petro-



Half-empty condition of one of the Croton reservoirs during the 1939-40 water shortage

When Water Shortage Threatens

TEW YORKERS have been so at customed to obtaining, at a mere twist of the wrist, an unfailing supply of clear, wholesome water that the probability of a water famine seems well nigh incomprehensible. However the shortage of the winter of 1939-40 intensified by a dry spell that began May 1939, is not the first of its kind, the city's history is punctuated with water crises of varying degrees, with even the early settlers of Manhattan having their troubles. In fact, the story of New York's water system is a chronicle of the city's constant growth and the efforts of the system to keep pace

The Dutch inhabitants in the 17th Century were the first to encounter difficulty. The increasing density of the growing population was making private wells unfeasible, as well as insanitary, and the year 1658 marked the construction of the first public well and the decline of the individual two

By 1832, the population had grown to nearly 200,000. Water conditions were intolerable. An epidemic of cholera was the impetus that led to the development of the Croton Watershed, 35 miles north of the city A small dam was built across the Croton River at a point where it drained an area of 352 square miles By the summer of 1842, work on the aqueduct had progressed sufficiently to permit water to flow from the Croton River to a distributing reservoir in the city The aqueduct had a capacity of 90 million gallons a day, and some engineers confidentially predicted that the water supply problem had been solved for all time But the city continued to grow and

Lessons Learned by New York City . . . Prolonged Wet Spells Give False Sense of Security . . . How Wastage May be Decreased to Conserve Supply

By EDWARD NUEBLING
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it became apparent that the yield of the watershed had been overestimated

At least the impounding reservoirs were too small to maintain the required supply through the long dry spell that started in 1880 and caused the city to experience its most harrowing water crisis the following year. In September 1881, rigid emergency measures had to be taken to reduce the consumption outlet gates of the reservoir in the city were partially closed, public fountains were shut off, street sprinkling was stopped, appeals were made to the pub he to economize on water consumption The heavens finally relented and a long rain saved the situation. It is a matter of record that another ten days of dry weather would have left the reservoirs as dry as the Sahara and the city's 1,200 000 inhabitants would have been without water

By 1885, the Croton Aqueduct had be come madequate to furnish the supply of water needed in the city, thus creating a shortage that was not due weather conditions. Work was begun on a new aqueduct having a capacity of 285 million gallons a day. Water was delivered through it to the city, for the first time in 1890, This was none too soon for the Old Croton Aqueduct was being forced to deliver water beyond its safe carrying capacity and was being subjected to pressures for which it was not designed

In 1895, a new supply of 20 million agalions a day from the Bronx and Byram Rivers, near the city, was made available. Three vears later, Greater New York came into being through the also represent the various communities lying in and about New York Harbor, the consolidated city includes the beroughs of Manhattan and the Bronx (the former city of New York). Brooklyn, Queens and Richmond The population of the Greater City in 1898 was 3,272, 420 of which 1,976,570 resided in Manhattan and the Bronx.

Upon consolidation, all of the pubhely owned plants within the greater city were placed by statute under the jury-diction of the Department of Water Supply Some 16 privately owned plants continued to be operated by the owners. Three large plants, one in Brooklyn and two in Queens, are still in operation

Shortly after consolidation, the necessity was foreseen of providing a large additional supply of water for the greater city as a whole So in 1907, construction

Courtesy of Water Works Engineering

was started on the development of the Esopus and Schoharie Watersheds in the Catakill Mountains, 100 miles north of the city However, construction work was started too late to avert another shortage of supply in 1911 The Croton Reservoirs were far below normal, and the supplies available to the other boroughs, which were obtained mostly from underground sources, were inadequate to meet the demand

The emergency measures of 1881, as well as new ones, were taken to relieve the condition For the first time, systematic underground waste work and house-to-house inspection for the detection and suppression of leaks was tried. This waste work was instrumental in holding down consumption until the present Catskill source was added to the system in 1917

The last water shortage incident occurred a decade ago. It was the peak of the boom period In a city of New York size, there is a definite correlation between business conditions and water consumption. good business means increased production, and many industries use large quantities of water A prolonged dry spell at this time (1930-1931) found the reservoirs emptying at an

alarming rate The Department of Water Supply's first action was to employ emer gency measures similar to those used so successfully in 1911 But it was not long before the repercussions of the stock market debacle began to be felt in industry At this juncture, and with a more immediate salutary effect on the water supply, capricious Nature dipped into one of those unpredictable wet cycles which was destined to last nearly a decade In the frenetic period of unemployment and national upheaval that prevailed, people soon forgot that there had been a threatened water famine

UT the engineers and experts of the Bull the engineers and specific and Department of Water Supply and the Board of Water Supply, a separate organization empowered to develop large additional sources of supply, did not forget In fact, they had anticipated the shortage, had been seeking an additional water source for a number of years. The upper Delaware Watershed, adjacent to the Esopus and Schoharie Watersheds. was finally decided upon as the best new source of supply

The concomitant wet cycle tended to imbue many people with a false sense of security Among these people was a group of citizens who minimized the neces sity of the costly Delaware project. They admitted the need for a new water supply in the near future, but believed that universal metering was the logical solution

Water was then, and is now, sold to domestic consumers in New York on a flat, yearly basis Under universal metering, each consumer would pay for the exact amount of water used This sys tem, it was contended, would eliminate waste and extravagant use and would result in an estimated saving of 200 million gallons a day. It was further pointed out that the cost of metering would be





New York City water consumption and supply

one tenth the cost of the Delaware development and would take one fifth the time. In other words, it was held that the Delaware development would add another heavy burden upon the taxpay ers, whereas metering would not

The proponents of the Delaware prosect counter-argued that when completed it would bring 540 million gallons a day to the city The constantly increasing population and the inevitable necessity of the project was emphasized

It was finally decided to proceed with the \$273,000,000 Delaware project Looking back now, it is agreed that both projects should have been started simultaneously But then, there was the question of money, which was, as usual, the main hone of contention

The Delaware project is to be built in two stages Actual construction on the first stage was begun in 1936 and will be completed about 1945. It will bring 170 million gallons a day to the city The commencement of the second stage, which will bring an additional 370 million gallons a day, will be held in abevance until the necessity for a larger supply becomes apparent.

Normally, 90 percent of the city's supply of water comes from impounding reservoirs in the Catskill and Croton Watersheds. The last reservoir added to the system was the 20,000 million gallon Schoharie Reservoir, which was placed in service in 1926 This brought the total available storage capacity of the Catskill and Croton systems up to 285,000 million gallons. While this enormous quantity of stored water would at the present time be used up in less than a year, it would have sufficed liberally for all of the wants of the old city from the time of settlement up to 1842 when Croton water was first supplied, a period of 230 years. The slow growth

of the city in its early period lends truth to the saving that "water supply establishes a dead-line beyond which no city can grow with safety and health." Shortly after Croton water was introduced, the per capita consumption increased from 35 gallons a day to 80 gallons, and, in the following 15 years, the population was doubled

I N April, 1939, all of the resoverflowing At the close of the year owing to low rainfall and run-off in the watersheds, there remained in storage only 129,-000 million gallons During the nine months from May through December, the reservoirs were depleted at the rate of 620 milbon gallons a day This rate of depletion, if continued, would leave the reservoirs empty by the summer of 1940.

In 1939, the consumption of water from municipal sources of supply averaged 963 million gallons a day. Of this amount, 22 million gallons a day were supplied to communities outside the city Private water companies operating within the city furnished 60 million gallons a day, bringing the total city's supply up to 1023 million gallons a day. The population served, including outside communities is estimated at 8,000,000. In addition, some 500,000 commuters enter and leave the city daily.

The dependable source of supplythat is to say, the supply of water that can be made continuously available through prolonged drought periods such as the city might now be passing through -amounts to only 990 million gallons a day. The demand for water last year exceeded the dependable supply. The only reason that the city is not now confronted with empty reservoirs and a water famine is that drought conditions did not prevail throughout the year and that private water companies are still pumping from ground water beds that are nearing exhaustion.

To remedy conditions, the Commissioner of the Department of Water Supply, Gas and Electricity, Joseph Goodman, outlined the following courses:

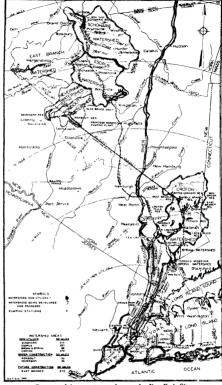
1. APPEALS TO THE PUBLIC TO STOP WASTE. The low stage of the impounding reservoirs was first called to the at-

tention of the public through the press last October, Heads of city departments have since been requested to repair all defective water fixtures in buildings under their jurisdiction. The use of water for street cleaning has been reduced to a minimum Posters were displayed in all cars of the subway lines giving no tice of the low stage of the reservoirs to the several million passengers who travel on the lines daily. One and a half mil lion folders, calling attention to the water shortage and the necessity for stopping waste from leaking faucets and toilets, were printed for distribution in schools and through other public and private agencies. In addition, the municipal and other radio stations helped with spot announcements, reminding the citizens of the water shortage and requesting co-operation in reducing waste

2 DEVELOPMENT OF ADDITIONAL WELLS IN LONG ISLAND When the Catskill supply was introduced in 1917. Long Island well sources were for a brief period discontinued However, as the city grew, the well supply was again drawn upon to supplement other sources Measures will now be taken to rehabili tate old wells so that the entire available supply may be utilized, and also to previde additional wells. The additional wells will add 50 million gallons a day to the system. However, the approval of the State Water Power and Control Commission must be obtained before this development can be undertaken

3 DETECTION AND SUPPRESSION OF LEAKY FIXTURES IN BUILDINGS. The last house-to-house inspection was made with WPA labor from 1934 to 1937 The survey took in 473,000 buildings, reveal ing 400,000 leaks. In one section of the city, one toilet out of every five exammed was found leaking Over 50 million gallons a day were being saved at the time of the project's discontinuance Since new leaks are continuously developing, house-to-house inspection must be repeated periodically to be of lasting benefit. At the present time, it is estimated that virtually all of the saving made on the last survey has disappeared and that by instituting another campaign, the consumption can again be reduced some 50 million gallons a day

4 DETECTION AND SUPPRESSION OF UNDERGROUND LEAKAGE. Water is conveyed from source to consumer through a vast and intricate underground network of 5000 miles of water mains and 640,000 service pipes. Leaks in this sub terranean system develop at the rate of 20,000 a year. Most leaks appear at the surface and are promptly repaired. However, an appreciable number flow through underground channels During the past ten years, a special force of men has been ferreting out these leaks in Manhattan and the Bronx, covering the two boroughs about once in three years It has maintained a saving of about 30



Present and future water-supply areas for New York City

million gallons a day that otherwise would have seeped irretrievably into the soil. Underground waste work is also being done by a WPA force in Brooklyin and Queens. Enlargement of the present force and extension of this work to all five boroughs should raise the savings to a total of 50 million gallons a day.

5 REDUCTION OF PRESSURES: It is estimated that well over 200 million gallons a day is now being lost from leaks in water fixtures and underground pipes. Obviously, by reducing the pressure in the pipes, the amount of leakage will be decreased. This method of reducing consumption, however, will be employed on a large scale only if it should become necessary to avoid emptying the reservoirs completely

It is estimated that the conservation measures outlined above, when in full swing, will reduce the demand for water in the city by 80 million gallons a day This saving, plus the additional well supply, may suffice for the needs of the city up to 1945

Soundless Sound Waves

(In Two Parts—Part Two)

E GOCENTRIC Man. unless he favors the Boston State House, usually considers himself the hub of the universe. From his point of view, a sound wave is that which he hears, from the universe's viewpoint, however, it is a longitudinal vibrational disturbance, usually of the air Thus is resolved the apparent contradiction in the tille of this attuel if the disturbance vibrates faster than about 20,000 cycles research it is unaudible to human ear-

in Mixing and Metaliserp:
Figure 1 An illustration of the
"principle of Bernoulli," which
is used in precipitating fumes

and these soundless sound waves are called ultrasonics

Apparent contradiction is not confined simply to the title but extends as well to the behavior of ultrasonics. For example, by dipping the bull of a glass thermometer into an ultrasonically-

vibrated oil bath one can enjoy the unique experience of having one's fingers burned despite the fact that the object held is, as evidenced by the thermometer reading, at all times at room temperature Or of ultrasonic vibrations are applied to an arm or a leg, the bone remams at the normal body temperature but the marrow is heated. The explanation hes in the fact that glass and bone conduct ultrasonic vibrations much more efficient ly than do flesh or marrow

The latter absorb the vibrations and, as a consequence, become heated.

An interesting illustration of this beating effect is given by a simple experiment. A mixture of water and ice will maintain a constaint temperature of 32 degrees. Fahrenheit, regardless of whether it is heated or cooled, until either all the ice has melted or all the water has frozen Hence, if a newly formed block of ice made from distilled water is immersed in a bath of cracked cre and water and ultrasonics are ap-

Supersonic Waves in Science and Industry . . . For Smoke Precipitation, Emulsification of Liquids, in Fishing and in War . . . Sounds that Burn

By WALTER L. FINLAY, Ch. E.

plied, both the both and the block will remain at 32 degrees. Fahrenheit But if after some exposure to the waves, the block is then squeezed, it will shatter the "rotten" ice, indicating that the vibrations had caused liquidation at the grain boundaries. Natural ice—that is, point ce—does not exhibit this effect.

The subrational energy which burnthe fingers holding the thermometer previously mentioned can be concerirated in a point with rather curious results. If the neck of a glass flask is heated and drawn out into a point, and ultrasonically-vibrated bath, the vibrational energy will be concentrated at the point A pine chip held on the point will be penetrated in short order by a combination of drilling and burn ing Even a plate of glass will have a hole drilled through it and during the process, tiny globules of molten glass



rom Dr B Claus in Zeit techs Physics Figure 2 Showing how ultrasonic vibrations facilitate the emulsification of some highly immiscible liquids Leit Result without vibration Right With vibration

will be flung off in a miniature shower. But ultrasonic vibrations provide more than just the main-spring of a magician's hat, for they have several rather important industrial applications. Ultrasonics of suitable intensity, for example, can precipitate tobacco smoke or the fitmes of NH,Cl. P₂O₂, SO₃ or HCl in one second This precipitation effect has been explained by Gottschalk and St Clair as an illustration of Bernoulli's principle in effect, this principle states that the pressure in a fluid

is least where the velocity is greatest. Thus, in Figure 1, at the left, the direction of vibration, that is, of motion of the air molecules, is perpendicular to the line of centers. Hence the pressure between the particles is lessened and the particles coalesce. In the same figure, at the right, the particles, oil including the property or are urged apart but it is simply a matter of time until the air property orneated to other particles for coalescence. Settling there fore is rapidly effected.

PRECIPITATION of smoke and fumes is an illustration of the ability of ultrasonics to destrye dispersions of solids or liquids in gases. But these paradoxical vibrations are also able to reduce dispersions of solids or liquids in liquids. Such highly immiscible liquids as mercury and water can be transformed into rather stable emulsions by ultrasonic radiation alone. And if

mercury is electro-deposited from an aqueous solution of one of its salts and is simultaneously subjected to ultrasonic vibrations, a much finer dispersion is obtained. This can be observed by comparing the two halves of Figure 2, which were photographed at 2000 magnification

Just how this emulaification by ultrasonics is effected is not clear but a large number of solids and liquids can be dispersed by this method If an already existing dispersion of colloidal—that is

ultramicroscopically sized—particle is subjected to these ubrations the colloidal particles become still further divided Milk, for example, is an emisson of fat, casein, and so on, in water fixed productions of fat, casein, and so on, in water fixed productions of fat, casein, and so on, in water fixed production of fat, casein, and so on, in water fixed productions of fat, casein, and so on, in water fixed production of fat, casein, and is so on, in which is not been good of multifaction by sonic radiation than Mother Nature was ever able to bring about, and Figure 3 shows the apparatus used. The advantage of this finer emilstification seems to be that smaller and size data for the size of the fat o

more easily digested curds are formed in the stomach. If the particles are laready of molecular size, very slow further subdivision may still occur. For example, starch may be converted into dextrine, and cane sugar may be split into monosactanides Of more practical importance is the fact that the homogeneity of photographic emissions is improved by ultrasonic radiation As a result, it is possible to increase the silver halide concentration with a consequent moreous measurement of the silver halide concentration with a consequent increase in resolving nower

I T has persuasively been suggested that the phenomenon of cavitation is the basis of ultrasonic emulsification but the exact mechanism of just how it brings about this effect is not yet clear Cavitation causes a tea kettle to "sing" just before boiling The harmony comes from a ballet of bubble dancers but, in this case, there is nothing behind the bubbles The singing arises from the condensation and collapse of steam globules as they rise into the colder water near the surface. When this colder region becomes sufficiently heated the bubbles cease their Swan Song and start to boil The late Lord Rayleigh calculated that pressures of thousands of atmospheres might be developed at the moment of collapse and, of course, at highly localized spots. That such pres sures are no mere mathematical abstrac tion is indicated by the cited fact that, during maneuvers, after a destroyer had rushed for several hours at maximum speed, the armor plates above the propeller were completely eroded through over an area of almost one square foot Turbine and propeller design must, of necessity take into account these cavitation effects in order to mitigate them Figure 4 illustrates the destructive pitting action of cavitation on the cast steel blade of a hydraulic turbine after 18



Courtesy Submarine Signal Company Figure 3. A two-foot, stainless steel disphragm with hinged cover, as used for sonic treatment of milk

In the ultrasonic radiation of a liquid, exitation is hrought about by the actual tearing apart of the liquid A sound wave is propagated in the form of periodic compressions and rarefactions of the propagating medium During the constantly recurring rarefaction phases of the wibration the liquid is literally stretched, and the resultant reduced





hydrostati pressure permits either dissolved gases or vapor of the liquid itself to form hubbles. Those bubbles which do not collapse are evolved from the highd. Application of this principle to the industrially important problem of removing dissolved gases from molten metals has formed the subject matter of several patents. A corollary effect is the lowering by as much as two degrees of the boiling points of many liquids

Ultrasonics are conducted much more efficiently in water than in air. In fact, communication and depth sounding are commercially carried out by its means In the "echo" system of depth sounding a burst of ultrasonics is sent out from a piezo crystal vibrated diaphragm on the ship's bottom. After reflection from the floor of the sea these vibrations are picked up by another similar diaphragm. The mezo crystal of the latter converts the vibratory changes in pressure to easily recorded electrical imnulses and the depth is automatically calculated from the elapsed time between transmission and reception. As many as 15 soundings per second can he made in this manner and an experienced observer can even distinguish between a mud rock, clay, or sand bot tum. The information obtained is of considerable value to commercial fishing trawlers. To polish off this facet of the many-sided ultrasonics as a real fish story, one need only relate that the exact location of close-swimming shoals of fish can be readily determined by the echo method. The fanciful might thus suppose that Mary Mackerel and Cathleen Cod can sense a premonitory chill as the searching beam of ultrasonics puts the finger on their svelte sides

Much smaller organisms than mask seried or ode skyretence more than a merely premonitory chill. To very small fish and vegetable growths bke protozou the mittal chill is also the final shall one of death. This lethal effect is problemore a cavatiation, degassing, and dispersion — which accompany ultrasonics.

Submerged submarines, by making

use of the echo principle, can determine their position by determining the contour of the occan floor and also while submergied, can locate, and fire topedoes at an enemy ship. Submarines are also communicate over distances as great as 10 to 15 miles and can concentrate the ultra-sonic beam within one degree of the direction desired. Tapping such a private "wire" presents some thing of a problem to an eave-dropping

Efficient as water is as a conductor of ultrasonic, metals are even more so. However, inclusions, cracks, blow-holes in fact any discontinuities in the metal are potent sources of reflection or absorption of the ultrasonic vibrations. Means for the non-destructive testing of metals is therefore provided by they phenomenon and a patent has been granted for this application.

It has also been claimed that ultrasonics accelerate the nitriding and carburizing of steel both of which important processes impart a hard skin or case to steel, the former by compounding with nitrogen and the latter by compounding with carbon Later investigations, however did not substantiate these contentions Nevertheless, other processes in solid metals may possibly be expedited by these vibrations A super-heated liquid flashes into vapor and a supersaturated liquid immediately precipitates upon ultrasonic radiation By analogy one might expect that such extremely important metallurgical processes in the solid state as the precipitation-hardening of age-hardening alloys such as duralumin and beryllium bronze and the austempering transformation in steel could be similarly accelerated

These versatile whrations are thus seen to be of interest to the scentiat, to the undustrialist and to the simply currious It is a relatively new field for most of the pioneering work in it has been done within the last 15 years. And, although soundless, it seems quite probable that ultrasonic withstons will be increasingly heard from in both in dustrial and seteration for increasingly heard from in both in dustrial and seteration for increasingly heard.

Railroads In The Cellar

WHEN a boy buys his father a toy train for Christmas, when a western Pennsylvania wife obtains a divorce because her husband spends too much time in the cellar "building rail roads—little railroads," and when the president of a large eastern transportation system considers it perfectly proper to officiate at the opening of a model railroad, then it is high time to investigate a hobby that is breaking all records for sustained interest, and one which, because of its very nature, is going to stay with us for a long time

Building and operating model railroads is not child's play, as one would ordinarily surmise, although it may have had its start from an urge to provide the youngster with more realistic equipment. But Junior isn't skilfail enough to do the building himself. Dad has to help, and before you know it. Dad is over his ears in a new hobby.

Immediately, the boy can forget about his train entirely I's Dad's now' And, incidentally, Junor sn't any too well-incidentally, Junor sn't any too well-train are running, Model of a work of the sn't and the sn't

Time made the mistake of talking fippantly about model railroading not so long ago, and almost immediately received the following rebuke from J. H Bramble, of Farrell, Pennsylvania

"Your phrase 'plays with toy trains' a Your phrase 'plays with toy trains' the hobby Would you refer to a philatelist as one who plays with bits of colored paper, to an antiquarian as a collector of junk, to a fisherman as ane who floats bugs on a string, or to a hunter as one who goes into the woods to kill things?

They're touchy, these model railroaders, even worse than ping-pong players; and there are, according to best estimates, nearly 100,000 of them in the country. But model railroading is not confined to the United States alone. One manufacturer of model-railroad equipment is proud of the fact that he has customers in Canada, Mevco, Central America, Panama, Cuba, Puerto Rico, the Argentine, Hawaii, New Zealand, the Philippines, England, Belgium, Italy, Sweden, and France.

It takes blue chips to play the game right, too, depending, of course, on the scale used There are cheap model railroad sets on the market — the hobby Capitalization of Model Railroads Now Runs Into Many Millions... Serious Avocation... Men Form Exclusive Clubs... Run Trains Like Railroaders

By R. T. GRIEBLING

has already reached that stage -- but the difference between one of these and a good set is as great as between a dollar watch and a fine Swiss movement Both tell the time, but the latter does it just a little bit better all the way round

Those of us who thought it was plumb crazy to pay up to \$100 for a mah jong set, can get ready to be shocked all over again Thirty-five dollar locomotive as sembly kits are as common as flies, and if you want a truly super-de-luxe engine, you'll pay as high as \$295 for it And don't forget that this sum pays for only one power unit and a tender, a good model railroader, proud of his set, has several of them Cars, unassembled, will run from \$350 to \$10 Rail for tracks costs about 5 to 10 cents a foot (completely assembled track costs \$1 a foot), and we haven't even begun to figure on ties, roadbed gravel, spikes, third-rail connections when necessary, frogs, switches, cross-overs, signal towers, waiting stations and other buildings, scenery, mannikins, transformers, and

WIRING as not always a coastly stem, but in some cases it impair will be. Consider, for example, the larges and most complete model rational ever built — exhibited at the New York World's Fair. The signalling system used 3,000,000 feet of wire. Other figures to make the eyes pop include 70,000 wood tree on 3500 feet of track, 125 switches, 100 picces of rolling stock. Six thousand miniature trees make up the forests, and 7000 gallons of water were needed for the waterways.

If this model railroad is the ultimate dream of the enthusiasis, then it explains the entire hobby. The attention given to detail is nothing short of remarkable, and therein lies the fascination that is exercised over both builder and specta-

The reason for model railroading's popularity is to be found in the ability to reproduce in miniature, with uncanny accuracy, the various pieces of equipment that go to make up a railroad. To

build a coach with six-wheel trucks, when only four wheel trucks are used on the prototype, is rank heresy, and model railroaders would be booed by their brethren for such maccuracy.

Models built entirely by hand are museum pieces and take many months to execute. These are emmently not the ones that are found in model railroads. The tiny locomotives and cars that serve model railroads come either assembled or in kits unassembled. If they are of the latter variety, they can be put to gether in a reasonably short time. It takes much longer, however, to lay the track and install the wring system. But anyone who has a knack for tools can ion, in the fun.

Fastidiousness is the principal joy of the model railroader Everything must be "just like on the big trains," or else it has no real hobby value. All parts are built to scale, so that the complete outfit is actually a vest-pocket edition of the real thing

And that brings to mund another increating fact about model railroading. Ever since the Union Pacific stream-liners made their appearance in 1934, the amount of aluminum used in model railroad construction has increased. And the sales arguments used by the manufacturers are quite similar to those used by the manufacturers are quite similar to those used by aluminum salesmen in real life

"Light weight and strength," says one maker, "are of vital importance in the manufacture of operating models, and this naturally brings us to the use of numerous aluminum castings."

"Duralumin rail," says another, "has everything in its favor Color similar to steel, will not rust, gives good bite to drivers, is hard but cuts and bends easily, no excessive slipping, good conductor of electricity, produces good sound effects as wheels roll over it, and is inexpensive"

Fully assembled units may be purchased at higher cost than kits, but most model railroaders have sufficient skill to put the unassembled cars together. They also have enough skill to build the platform on which the model system runs. What a model railroader's cellar looks like. Right. The owner, S. T. Gustna, is shown in the foreground lowering a lift bridge. When the road is not in use, the bridge is lifted out of the way by counterweights, Below. Classification yards with three locomotives and several kinds of passenger and freight cars. A continuous landscape is painted all around the wall





Below On the main line! An aluminum truss bridge carries the track over the space before the vegetable cellar door Again, note background mountain scenery





Another view of the lift bridge which carries the track across the room, showing cross-over switches, signal tower, and semaphore. A turntable, operated by a crank, is in the rear near where the track turns under the cellar step

This requires some knowledge of car-

In model railroading there is even a place for the man who has no skill whatever but would like to indulge in the sport. Since elaborate systems are quite costly (even a real hobbyist can seldom afford them!), groups of enthusiasts band themselves together into clubs, collect monthly dues, hire some space, buy whatever equipment they need, add to this from month to month, and build the road in their spare time. The skilled members lay the tracks and assemble the signal system; the unskilled mem bers keep the books, figure out operating schedules, and do the other chores that are commonly done in real-life railroads. "Club night" to these enthusiasts means a night in the selected space or in

the cellar of one or another member, "working on the railroad" And once they are at it, no interference is tolerated. They are indeed serious, these model railroad men!

The model railroad has arrived. If each of the estimated 100,000 enthusiasts own 100 feet of track — and there are many who own more—then, by laying all sets together, it would be possible to run a single track line from New York to San Antonio, Texas, or double track from New York to Musakee.

And if there are 50,000 model trains in use (the figure, to the best of our knowledge, is conservative), then on the run from New York to San Antonio you would meet a train every 200 feet. If you figure that there is \$200 invested for every 200 feet of track (\$75 for the

carefully detailed locomotive, \$10 each for six cars, \$20 to \$40 for 200 feet of track, depending upon the type of construction, and \$25 for transformers, wiring, and control systems), then more than \$10,000,000 has already been spent on this hobby

Some friend of yours may say to you, one of these dax "I sure heat 'er on the back on the high iron last night!" If he does, please don't stare at him Remember, you have always thought of him as a respected, conservative citizen with a good job, a nice home, and all the other accessories of the more abundant life. He's just talking railroad lingo, referring to the fast time his train made on the man line of his model railroad. Bear with him. You might be the next one to get the bug.

FOOD BY VEIN

An important new was to produce life has just been discovered Food is now being given by vern to patients who cannot eat - because of excessive weakness at the time of operation or because the surgeon must cut some portion of the alimentary tract, as in removing a tumor. The new method is already being used in hospitals and enables patients to survive digestive crosse hitherto often fatal.

Of course calories for heat energy, have long been given by vein in the form of a solution of the simple sugar dextrose, and the body is thus supplied with a priceless source of immediate energy with which to run the human mechanism. The indispensable, carbohy-drate component of the diet is taken care of in this way.

Salt solutions also have long been provided by vein, and the mineral component of the diet is accounted for Ex istence for weeks is possible without vitamins, although they have in many cases been found to mean the difference between death and continued life. Now a number of pure vitamins -- including vitamin A, thiamin, ascorbic acid, riboflavin, nicotinic acid, B., D. E. and K are commercially available and are injected as a common practice. Some are safely given by vein, others by administration under the skin so that they are only very slowly absorbed into the blood Ultra-violet rays synthesize small quantities of vitamin D in the skin upon which such light is made to fall. So the vitamin problem has not been a major obstacle to successful surgery and convalescence

The fat component of the diet can be dispensed with, for many days at least, if not weeks. But even fat has been provided by injection. In 1935, Dr. Emmett Holt Jr., and his associates at Johns Hopkins Hospital made exceedingly fine emulsions of fat - olive oil - and injected the preparation into dying patients Improvement followed Inasmuch as fat is not only an essential nutrient and must eventually be taken if the patient is to remain alive but also a more efficient source of energy, weight for weight than carbohydrate, future developments in fat administration will be important and should bring new successes that will permit the patient to recover more rapidly

Water, sugar, mineral salt vitamin, and fat are five of the six nutrients known to be indispensable in human nutrition. The sixth is protein, until recently the main obstacle in the way of perfecting the administration of food of perfecting the administration of food.

Hospitals are Beginning to Use the New Method of Supplying Food to Those Who Cannot Eat . . . The Expectations are Auspicious

By BARCLAY MOON NEWMAN

by vein, through an extended period Now for the first time in medical history, there is a satisfactory substitute for protein-by-mouth Bases for the complete solution of the problem of intravenous feeding—of food by vein have been established. The digestive tractcan be completely dispensed with for weeks Meanwhile, it can in many cases be restored to approximately normal



One of the methods of injecting food by vein is by the syringe

activity Thus the patient balks death Credit goes to Doctors Robert Elman and D. O. Weiner, of the Department of Surgery, Washington University School of Medicine, and of the St. Louis City, the St. Louis Children's, and the

Barnes hospitals, St Louis
These doctors knew that it would be
dangerous to try to inject into the veins
even the most carefully purified protion such as casein from milk. The
blood and tissues of the body cannot
loop with foods so intricate for protion is the most complex chemical structure in the world A first injection of
casein would sensitize the body so that
a second injection would result in a
terrific shock, very likely to be fatal.
This sensitization to protein is an unavoidable, normal body reaction, a condition like that of allergy is set up, It

is the work, instead, of the digestive tract to break down proteins so that only fragments of the former huge molecules are made available for absorption

The ferments of the digestive juices are the catalysts that bring about this cracking of the protein molecule into its main constituents or component units, known as amino acids. Following such decomposition, absorption of these simple chemical structures, the amino acids, occurs. These building blocks of the proteins thus arrive in the blood stream, which transports them to tissues that in turn absorb them. Once in the tissues throughout the body, the amino acids are, in utterly unknown chemical reactions put together so that new protein, the chief basis of living tissue, is synthesized Without a steady supply of amino acids tissues degenerate and die and the body dies. With a steady supply of amino acids, usually derived from food protein, tissue is constantly regenerated to replace that which is lost in those activities which we call life.

TISSUES starving for protein be come pathologically swollen with excess water, but when protein-building units are supplied, the swelling subsides Other less obvious changes take place and the patient grows stronger with the trend back to normal

To a limited extent, serum from a blood donor may be used to supply amino acids. But even a quart of serum a day will not yield enough building blocks to construct the large numbers of protein molecules required throughout the tissues.

Doctors Elman and Weiner had learned that in 1913, two other scientists. Henrque and Andersen, had kept a goat alive and gaining weight by food was wen. The source of protein building blocks, the amino acids, was meat whose protein had been digested in the test tube. Also, Van Slyke and Myer had sent digested protein courage through the blood vessels of dogs, and no harm had been done.

With these favorable discoveries in mind, Doctors Elman and Weiner digested casen with acid, and so prepared a mixture of most of the indiagensable building blocks of protein. The send, however, decomposed one of the send, towever, decomposed one of the and casen, to begin with, is low in another, called cystine, an invaluable source of suitur for protein, therefore the mixture was fortified with a small percentage of tryptophane and a little cystine—amino acids which can be bought on the market.

The preparation was tried first on rats. They grew and thrived Further experimenting showed that the preparation was free from dangerous, undigested protein In this test, guinea pigs were used Repeated injection did not bring about a sensitived condition, and no shock resulted.

Next came the due, into which the miber solution of ammo acids plus some sugar was injected. Careful meas are ments of the level of ammo acids in the due's blood were then made, and it was found that the injected nutrients rapidh and safely disappared from the blood, certainly to go into the tissues, there to be caught up in the swell of life's chemical laboratories and made into cannie protein. Little of it seemed to be wasted by way of the kindneys The method appeared to be efficient

In one set of experiments, the dogwere allowed to fast, and a certain quantity of blood was drawn, to reduce the quantity of protein in the blood serum. Then amino acids were given by vein Re-synthesis of lost protein occurred within six hours after the injection of these protein-building blocks.

In another series of experiments, dogs, were fed a due free of protein, for several weeks. Serum protein was observed to ank to lower and lower levels, and characteristic accumulation of water amino acid-dextrose solution was administered by vein, the amount of protein in the dogs blood serum rose to-ward the normal level. The most carried examination, moreover, showed no damage to liver or kidney or other organ. Now for human beings

"Our first concern," the two ponener report, "in giving diagested casein to patients was, of course, the possibility of untoward reactions, even though none had occurred in dogs At first, small doses were injected, they produced no demonstrable effect, so that eventually we administered what was thought to be a full daily quots of amino acids, that is, from one half to two grams per kilogram of body weight."

A sense of warmth was noticed by one patient; a slight chill was felt by another, but the temperature remained normal. A child had a slight, transient rash after one of the injections. In practically every instance, benefit came from amino acids by vein, and water-logging of tusues was diminished No injurious after-effect whatsoever could be seen All the tests gave proof of the body's use of amino acids to build up new molecules in tissues that had been starving for protein

Still, the substitute for food by mouth is only a temporary measure. The present limit of food by vem is a few weeks at most. One vem cannot be used con-



Food is also given by vein by a continuous method ("venoclysis")

tinuously, so vein after vein must be subjected to the inflow of fluid, and generally the first vein has not recovered sufficiently by the time all the veins have been used

We do, however, have a great beginning Deeper blood vessels may turn out to be available for use, when better techniques have been devised. While more is learned about protein-building amino acids probably some of the less important ones can be temporarily dispensed with, and the injected quantity keet at a minimum.

Practical possibilities are increasing as amino acids become cheaper through improved commercial syntheses. Drug manufacturers already have placed predigested casein preparations on the market, and with such solutions universally available for research, we can expect further notable developments.

Perhaps we can look forward to a considerable extension of the periods during which patients can be kept alive though their digestive tracts are not working. Approximately seven percent of all deaths after the age of 45 is caused by disease of the digestive system. This mortality should be reduced as the use of food by ven is increased through the development of refinements both from the untritional side, where better methods of forcing fluids into veins the second of the control o

are concerned The fluid undoubtedly will be made nutritionally more valuable The ven through which the fluid is forced will surely be more satisfactority guarded against possible injury. The stomach, the intestines, the liver and the pancreas will be given longer periods of rest and a greater opportunity to return to health

Fifty percent of cancer deaths rtraceable to cancer organiting in the digestive system Already, through the contributions of Dictors Elman and Wemer, a practical step has been taken toward helping the cancer specialist in his yard labors, operation is safer, because there is less danger of starvation following surgery of the digestive tract

INDOUBTEDLY, the main dietary components are known to nutrition ists and, by one method or another, in jection has been made practical, at least to a degree But none would assert that the optimum proportions of the various food factors have been determined, for one thing, age will have to be considered more carefully What percentages of what amino acids are best for the year old, the decade-old, the semi-centenarian, or the aged? Here a vast research for the future looms. And, even if we now know enough about the main essential items of diet to keep a person alive with food by vein over a period of weeks. no scientist would state that other factors vet undiscovered, do not after a while become indispensable for longer

Most experts believe that several ad ditional vitamins are to be turned up, perhaps including vitamins M. P. and factors U and W, the evidence at present pointing to the existence of these and others

Not long ago, copper was added to the list of indispensable metallic elements included in the group termed "mineral salts". Some think that cobalt and zinc, perhaps other metals, in ultravisible quantities will turn out to benecessary.

necessary

There are excellent indications also that dextrove does not altogether satistly the body's demand for sugar. There are other sugars, including the most one half of the molecule of milk sugar, one half of the molecule of milk sugar, dextrose being the other half Galactose is abundant in brain and nerve tissue and present in considerable quantities in every tissue of the body. No tissue (except that of the lactating mammary gland) is known to be able to synthesize galactose.

None can ever say how far medical science will go Research brings astonishing powers to delay death Food by vein is a major advance in the science of prolonging life. The future of this system can certainly be awaited with high hopes.



MONTHLY

"DAMP COLD" BETTER THAN DRY COLD

ODERN home air conditioning is grad-M ODERN home air conditioning is grad-ually teaching us that one of our most widely cherished beliefs is a complete fallacy -the one that says "you feel 'damp cold' so much more than you do 'dry cold'."

Actually, the National Warm Air Heating and Air Conditioning Association points out, the reverse is true Relatively high humidity causes low temperature to be less uncomfortable, and when prople have learned thus, they can begin really to enjoy the increased comfort, and even more the improved health, which can be provided by the simple type of air conditioning which is becoming the rule in modern American homes

It sen't the temperature that the thermometer shows that tells the whole story as to whether you feel comfortable, or cold, but the rate at which your body is losing you, the faster you lose heat, other things being equal, but other things never are guite equal Under most conditions you lose heat faster to dry air than to relatively moist air, faster to dense air than to thin air, and faster to air in motion than to still air And if you are in bright sunlight, even on a cold day, you receive enough radiant heat to make up for a lot of your loss, and so don't feel the cold so much. The kind of cold people think of as "dry cold" actually found in the thin air of high alti tudes, on still days of bright sunlight, and what they call "damp cold" is that of a cloudy day with a raw wind, on which you lose heat faster, and there is less radiant heat from sunlight to make up for it

NEW KIND OF BLOOD BANK

MOTHERS, as they bring new life into the world, are also contributing blood that has life-saving properties in Massachusetts Memorial Hospitals, Boston This novel sort of blood bank is stocked with blood from the placents, secured during normal, healthy childbirths through the cord through which the baby got its nour ishment before birth. After typing, to tell whether the blood will mix safely with the blood of a prospective patient, other tests and the addition of a special preservative, the mother's blood is stored for use, and Conducted by F. D. McHUGH

Contributing Editor ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

remains good for three weeks and even longer. This special sort of blood has a stimulating effect and is successfully used on desperately ill patients suffering from mainstrition, secondary anemia, hemorrhage after childbirth, and from certain types of cancer, ulcers, and gall bladder, stomach and bladder disorders - Science Service

MENDING PASTE PLASTIC

NEWLY arrived on the market is a multi-use paste plastic in colors, which should be welcomed by the home handy-man and hobby-crafter Packaged in small tubes and in cans under the name of Plastico Rok, this material is adaptable for use on those varied mending jobs that are always spring ing up in the home.

It is simple to use, clean, comes in ten beautiful colors and is an ideal mending material for cracks, dents, or holes, in wood, stucco, linoleum, and like materials. It acts as a powerful cement, besides the added advantage of allowing use of a binding material of the same color as the material or object being mended

Advantages of Plastico Rok are that no special thinner is needed and excess may be wiped off with a wet finger or a damp cloth Thus, it may be used on the finest furniture without fear of marring the finish After application, Plastico Rok quickly dries literally "as hard as rock

"BICARB" FROM CLEANEST CHEMICAL PLANT

THE manufacturers of Cow Brand and THE manufacturers or con Sound Marm & Hammer Brand baking sods will probably say that their product is not now any purer, that it was always as pure as it iumanly possible to make it, but these wasi two brands are now being made in what is said to be the world's cleanest chemical

The modern plant of Church & Dwight Company, Inc. shown in our illustration,



Functional design characterises this modern chemical plant

is not only striking in appearance but is actually simply an air conditioned "package" to support and enclose conveyors, car appearance of the support of the support of the with standard street. The plant hands and will so glazed the and functional panels of glass block instead of windows its entire framework was electrically welded, as was most of the equipment required for the new continuous process. Produced from start to finish in an enclosed maze of equipment, the brearboast of sods will not even come in contact with air naide the plant until its ready for penkaging.

Engineer Discovers "Lightning" Radiation

DISCOVERY that lightning generates an ultra short wave radiation which it uses to open a path to ground through a lightning arrester after striking an electric



Two things—motor trucks and the relatively new process of adhering rubber to metal—provide the modern means of transporting large quantities of chemicals shown here. This special trailer tank of 2500 gallon capacity is lined with rubber so that it will carry corroive solution. It is no of two such trucks put in service by the American Cyanemid and Chemical Corporation; the tanks were lined by the Goodyser Velaclock process.



High-frequency radiation in the gap between the spheres makes the gap "fast"

power system, was reported recently by W E Berkey, research engineer of the Westinghouse Electric & Manufacturing Company. He made the discovery while experimenting with lighting arresters. He said the newly tagged radiation is emitted from the regions of an arrester's electrode insulator contacts which are stressed by a lighting sure.

By generating ions, or charged particles, in the six space separating the electrodes of a spark gap inside a lightiming arrester, the radiation lowers the gap's resistance to the flow of electricity. It acts as a trigger to start the lighting surge jumping serous the gap toward the ground. In engineering stang, it makes the gap "fast," when speed is dealt with in terms of fractions of a millionth of a second.

"As a result of our discoveries," Mr Berkey said, "we can control and increase the intensity of this radiation and can improve the spark gaps of our lightning ar-

The investigator described the radiation as being near the soft X-ray region of the spectrum, with a wavelength of approximately only 1000 Angstroms as compared with 5000 Angstroms for visible light. (An Angstrom is a unit of measurement so small that there are some 254,000,000 of them to

an inch)
Shori-wave radio power which travels
through the air at several million cycles
a second appears to be loafing when compared with the frequency of the new radia
tion, which oscillates one quadrillion times
a second Because this radiation is absorbed in a few centimeters of air, it has

GLYCERINE SAVES

CLYCERINE is hygroscopic That is, it attracts and holds moisture Therefore, when Dr. R. N. Du Puis, of Cheago, studied the problem of preserving the roets of young tomato and cabbage plants during shipment, he turned to this sweetish liquid.

Every year, millions of young tomato and cabbage plants are shipped long distances Ordinarily their roots are packed in moist sphagnum moss. Too often the monsture drief out and the plants were damaged, so so Dr. Du. Paus thought of using a solution of Dr. Du. Paus thought of using a solution of glycerne instead of plans water to mosten the moss. As a result, more than 75 million plants were shapped satisfactorily during the last season with this glycerne-solution protection. It was found, incidentally, that the treatment also discourages the fungus that causes stem canker.

Encouraging results have also been obtained in the use of this solution with other plants such as narcissus, onion, potato, asparagus, and horseradish

ON THE HOOF

A PPROXIMATELY seven million tons of live stock enough to keep New York City supplied with n.cat for seven years were transportated by American railroads in a single year

DISPLAY SIGNS SAVE

THE high light transmission and edgelighting qualities of Lucite, methyl methacerslate, a du Pont plastic, have been unlited by the Lauv-late Corporation to make a new type of display sign, claimed to have several times as great visibility at less power consumption, and to operate at lower mantenance cost than other types signs which, furthermore, are said to have me glare or dead gots.

The signs are made by outlaining the desired letters, figures, or other patterns with small button-lenses of the plastic. These lenses, ground from small diameter rods, are fitted into holes punched through the face of the signs. The back of the lenses pick up light from a concealed source and carry it to the head of the lens, groung a sharp, bright glow. One lamp provides illumination for several lenses, and in the event that a lamp fails, enough light is picked up from other lamps to maintain vashility.

On and off and moving effects can be obtained in any color by using various color combinations of lenses and blinking bulbs.

The signs vary from small indoor counter displays to large and spectacular types for outdoors. For the latter, Lucite's resistance to extremes of atmospheric conditions without discoloration or warpage, and its high tensile strength, are especially advantageous

TRACTORS BY AIR

ONE of our photographs shows a Bellanca Aircruiser specially modified for use in gold mining in the Philippines. The



Cargo hatch in miner's airplane

Davio Cold Mine: s- productive of untold wealth, as a gold mine abould be, but it as one-sends and extent and extent programs. The Articles brings to the new control of the production as a Diosel electric power unit, else the production of the surrounding ridges at the time, all lendings are made towards the east, along the single presading direction of the word — A K

PHOTS

I N mid-January, more than 35,000 hours had already been flown by the 9130 students in the Civilian Pilot Training Program, without serious accident of any kind Furthermore, a total of more than 1200 of these students had already reached the solo stage of instruction

MODERN TRAINING PLANES

IN the World War I, the training planes were Curtiss Jennies and Standards with a top speed of 75 miles per hour, with all worts of projecting struts and wires, logy and slow to respond to the controls

Even today, w. are apt to think of a transplane as something like an Aeronao or a 'ub - small, alow, and safe, but a military plott who is to maneuer a 400-mile-an-hour single-seater, cannot possibly pass from a 'ub class' directly to the fighting class Our photograph shows the Curtus Falcon Carlon and the contract of the first of a large number just completed for a foreign severement by the Curtus-Wight Corporasceriments by the Curtus-Wight Corp

While designed for less spectacular service than the Curtiss Hawk Pursuit ships doing such remarkable things on the West ern Front, the Falcon is a splendid example of modern military design. Although it is a trainer, it incorporates every secodynamic structural device of the day with perfect streamlining, retractable landing gear, all-metal construction. The front cockpit is equipped for the pilot, while the rear cockpit is prepared for a gunner or observer or mistructor or bomber.

Performance figures give a maximum speed of 215 miles per hour at critical altitude, climb of nearly 5000 teet in three minutes, service ceiling of 25,000 feet, critising range of 515 miles -A K

PNEUMATIC SEAPLANE FLOATS

An interesting development is now reaching successful completion in the Mc bulley pneumatic floats for eaplianes. The interst application of the float is to small airplanes. One of our photographs shows the pointment floats mounted on a club plane, a ship of no greater weight than 1000 pounds. The PP 2 model float is 21 feet 9 inches in length and 225% inches in disameter at the point of maximum girth The weight of each float is only 42½ pounds. The material used is of standard airship fabric type—I longfilher cutton treated with lare so of rubber. Special centure is used it was a fine of the property of the control of the contr

The step, which is of importance in seaplane take-off, is tailored into the fabric.



Air-inflated pontoons

Spray tubes extend from the nose to the step. These tubes, held in place by cement, divert the water in taxing to a take-off, diminish spray, and also conduct a stream of air on the under side of the float, which aids in breaking the water seal.

Each float is divided into five compart ments, but in place of a rigid bulk-head separating the compartments, a fabric dia phragm is utilized. The fitth compartment in the nose also serves as a pneumatic bumper. The only rigid member in the float is a V-beam for attachment of the struts and to provide a walk. This beam is of duraliumin suitably protected against corro-

Advantages claimed for the float are its shock-absorption qualities, its lightness, and economy in maintenance

In experiments extending over 300 hours of service, deliberate collisions have been made with driftwood, buoys and other objects at high taxing and take-off speeds Resiliency was proved in every instance and no damage was incurred. Drop tests have proved equally satisfactory - A K.

ANNUAL REPORT

THE Annual Report of the Bureau of Aeronautics, submitted by Rear Ad miral J H Towers, gives a splendid picture of the energetic efforts of the Bureau of Aeronautics in advancing naval aviation Naturally, of course, it does not disclose the details of all that is being done.

Glaneing through the report we found some technical tenson of particular interest. Thus, in testing sirplanes to destruction. Thus, in testing sirplanes to destruction stress distribution is now also measured. The constructor not only knows that his ships interease its old, but where the danger ous points of attense concentration were. As high interest in speed, wibstain becomes more and more of a danger, so it is logical to include shirtson surveys. On landing, the weaplane or flying boat takes a terrible under continual investigation. It is good owns to hear that a light, automatic plot in the speed of the shirtson surveys. On the set of the automatic plot in private flying.

The Bureau takes particular pride in the variable venturi nonicing type of carbure for A meter to measure the quantity of fuel in aircraft now has the remarkable accuracy of 0.25 percent. 4 K.

WHITE-LEAD PAINT IN COLORS

ANNOUNCEMENT has been made that several of the leading mixed paint manufacturers are this spring offering ready mixed pure white lead paint in colors

reads mixed pure white lead paint in colors

Both professional painting contractors
and consumers will consider this departure



Modern military design in the Curtiss Falcon 22



which are the proof of your skill as a gar-Such results are easy to obtain when you

use scientific methods. Experts any that four out of five lawn and garden failures are due to soil deficiencies that could easily be corrected by soil testing



Weak, Sickly Growth ed by lack of phosphorus or incorrect scridity Ex agen causes solt, weak nd reduces disease resist

Retarded Development
Lack of annogen retards feel growth
forufficient phosphorus or possibility
means slow establishment of seed
lings and poor root growth Excess
possibility disks muturity

CHAPERONE FREE

to pre-season buyers

Order your Sudbury Soil Test Kit early, and we'll send you FREE a full 4-ounce bottle of Llquid Chaperone—the wonderful new dog repellent that rain does not weak swey. This special offer must be withdrawn offer he stort of the active



WHAT USERS SAY

tial to healthy plant growth

before you plant

Amazing Results—We have in our files dozens of letters from users who tell us of the amazing results they have obtained with Sudbury Soil Test Kits Here is an unsolicated letter from Mr George Thurksuf of Englewood, N. J.

Danger of Over-Fertilizing—As most gardeners know, a soil that is too and or too slakine acts as a poison to many plants. But did you realize as a poison to many plants. But did you realize Too much nitrogen leads to general weakness and hinders flower formation. Excess potash slows up growth. You can prevent these disappointments before you called rest. too —by teening your soil before you called.

"If gove exhibition dahitas This year I cleaned up teth them, and ms success uses due to your product. It was not a case of hit and miss when I applied my feetliteer. I know what my soil needed and my results. Saved His Lawn—Another user says "My lawn was in bad shape for three years, and I thought I'd have to dig it up I decided to test my soil first and got one of your test I followed the instructions, and my lawn is perfect now. This hit certainly saved me a lot of trouble and expense."

It's Fuer—It's Easy—If you like to work with your hands—and get at the whys and wherefores of what you do—you'll find soil testing a fascinating subject. You get results in ten minutes time. No specialized training required

A Permanent Investment — Best of all, your suddours kit is a permanent investment. With the inexpensive refills now available, you can use it year after year.

SEND NO MONEY'

We want to help you make your first soil test. Take a Sudbury Kit out into the garden, and judge useful as well as we say. If you think not—if for any reason you are not delighted with your kit—you can return it to us and we will gladly refund the full purchase you can even necessity to send any kit arrives. Only 14 15 plus few cents postage. Enjoy your garden as you never have before Use this handy coupen now.

MAIL THIS COUPON NOW

Sudbury Soil Testing Laboratory P O Box 711, South Sudbury, Mass.

Picase send me one Sudbury Soil Test hit. New Glub Model. I will pay the postman \$4.75 plus few cents postage. I understand that you will refund the full purchase price, if I am not de-lighted with the kit.

Check here if Please send me free 4-our you hay early as offered

Name Address

City

Want us to pay postage? Check here, enclose \$4.75 and we will ship prepaid harmemoney back guarantee.

Copyright, 1948, Sudbury Soil Testing Laboratory, Sc. Sudbury.

is manufacturing procedure as good news, for the ready-mixed, pure white-lead paint is colors returns all the beauty, durability, and high protective qualities of the homemixed, pure white-lead and oil paint. This manufacturing development not can supplement the usual practice of purchasing whitelead paste, lineed oil, turpentine, diret and untring them on the job with colors-interior to the process of the process of the protection.

COST OF TREE PLANTING

ONE and one quarter cents is the cost of each of the many millions of trees planted by the U. S. Forest Service during 1938. The average tree cost the Service about two fifths of a cent to produce and another four fifths of a cent to plant.

MORE USES FOR NYLON

N LION, which was discussed in detail in our February issue, has been adapted to other uses not mentioned in that article. A new patent, just issued posthimously to the Du Pour chemist, Dr Wallace H. Carothers, overs the use of this coal, air, and water product to coal paper, leather, cloth, and were mesh, for making a superior patent leather; long-wearing, flexible, waterproof clothing, and a sturry, transparent

window glass. When the chemicals, known as polyamides, are pressed into goats' leather, a new type of patent leather is produced that is more highly resistant to cracking than ordinary patent leather. They strengthen and disary patent leather. They strengthen and water-proof cotton cloth. On wire mesh they make a window "glass" that transmits ultra-voided high. Many, similar applications for them have been suggested.

AUTOMATIC RIFLE

PROCUREMENT

THE question has often been raised as to how rangid we might equip our Army with the new Garand automatic ride discussed in February, 1939, sues of Scientific American. At recent hearings before the Senate Appropriations Committee, Brigadier-Leneral L. D. Gasser, Assistant Chief of Staff, disclosed the fact that early chief of Staff, disclosed the fact that early these rides and was getting, more rides and was getting, more these rides and was getting, more these rides and was getting more than the rate of about 1900 a month. He stated further that it is expected that the Army will have 150,000 by June, 1942.

To these figures, we might add the comment that this is simply peace-time production, and that in case we should go to war, production would be stepped up considerably. The one one naing would be the matter of tooling up more plants for large scale production, and that, of course, would repeat the delays which we expertenced in 1917 practically all along the line.

AUTOMATIC BOOSTER ENGINE FOR TRUCKS

BENEFITS of vital importance to truckers, and particularly to those specializing in heavy-duty long-distance hauling—as well as highway safety advantages of a most important nature—are claimed for a

new booster unit which the Clark Equipment Company has been developing over the past two years, and which has now reached the point where experimental jobs are said to be giving excellent account of themselves on the road The Commercial Car Department of Chevrolet is co-operating in the development.

The heart of the unit consusts of an auxiliary gasoline engine which automatically starts when greater power is needed for a grade, and which delivers its output to the rear zale of a 1½-jon truck or tractor through a simple and sturdy over-running clutch. Automatic starting, speed governing, and stopping are provided, the entire cycle of operation being independent of the driver.

on operation design independent of one univermedium-duly whole performance characteristics of units costing considerably more, but to do this without entaining the high initial outlay and high operating and maintenance cost involved with heavy-duly units Forty-five horsepower, providing approximately 55 perior additional torque, is made available, automatically, for quicker starts hills, and the proper performance on

The engine of the Clark Automatic Boos



Above Booster engine controls under hood. Below Placement of booster in chassis. Lower right. Photo of booster engine in place

and an automatic throttle control. In present, these interrelated units work together to start, control, and stop the booster engine, and saure a smooth, positive flow of power from it to the transmission, when, and only when, the need for extra power exists. Each phase of the booster's operation is automatic and instantaneous, the entire vecle being completed in a fraction of the time it takes to describe it.

MILK

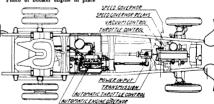
OWLREST'S Alice, a Jersey cow at the New York State Experiment Station, now in her twelfth year, has not only mothered ten calves but has also produced over 90,200 pounds of milk testing 5.66 percent fat.

PRINTING PROCESS

THE limiting factor on printing speed today is the time required for liquid into dry. Heat, more heat at a higher temperature, has been applied until the paper has been tried to the limits of its endurance in many cases.

A new approach to the problem of high speed printing and better printing is now offered in the form of ink and apparatis combined in a printing process which sets or dries ink by cold, not by hear I promises to relieve the paper manufacturer of many of the problems which he now faces as a consequence of too much penetration and too much hear.

Cold-set printing is the process of drying ink by freezing instead of by absorption, evaporation, oxidation, or polymerization. All inks when dry on the paper are solid mixtures of color and binder. In the processes of printing, however, the ink must be fluid in order to feed from the fountain to



ter comes into use only when the main egine is unequal to condition of road and load, and throws out when the main engine can take care of the load alone. The hoosier has two principal uses; to get the tractortrailer combination up to road speed quickly from a standing start, and to maintain cruising speed once the unit is under way. An ingenious, yet sturdy and dependable system of controls not only makes that possible, but the booster being succession of the draw, the booster being succession to the main cargine at all turns.

These controls comprise a speed governor, a vacuum governor, an accelerator governor,



the relief printing surfaces in controlled amounts. In customery printing, the fluidity is obtained by using fluids and a fluid mixture of color and binder is deposited on the paper. This creates the printer's major problem: drying

In the cold-set process, the fluidity of the ink necessary to feed it properly from the fountain to the relief surfaces is realized simply by melting the solid which is finally wanted as a deposit on the paper. The fountain, the ink carriage steels, and the plate cylinder are all heated by hot water from within. This keeps the normally solid ink touches the cold paper (that is, cold as com pared with the temperature of the ink) the ink freezes or solidifies without penetration and remains as a solid deposit in relief on the top of the fibers. Thus the paper fibers may be loose or tight. They may be uncoated or coated. The cold set ink from a half tone dot, for example, always sits on top of the fibers or coating in sharp relief right where it was deposited There is no lateral spread or vertical penetration due to fiber suction as with liquid inks

IODINE MOST POTENT

JOINE has come through a new series of tests in which it retained its title as most powerful germ-killer, at least against outsigned and the series as theoretically as the series which cause typhous such as, for example, John. The tests and results were described by Dr. A. J. Salle and W. A. McOmme, of the University of California, at a meeting of the Society of American Bacteriolousias.

Of the other halogens (chemicals close to iodine, such as floatine, broomer, and chlorine) the chlorine compounds, acid-horamic also appeared to be highly potent germeides. After these, additionatine, also appeared to their germ-killing chemicals were effective against the two test organisms in the following order the phenols Catoble and compounds), allever compounds, allever compounds, Section Service.

MOTOR TORPEDO BOATS FOR THE U. S. NAVY

POR several years, the British and the Italian arvise, and perhaps others also, have constructed and experimented will large numbers of small, high speed locate which, for operation in relatively restricted waters, possess great potentialistice as defensive weapons able to administer a disease of the proportionately powerful starp As described on the proportionately powerful starp, As described on the proportionately powerful starp, As described on the proportionately powerful starp, As described on the proportionately fact and the proportionately fact and the proportionately arrived for the proposition of the pro

Among American naval men. it has been said that we could have no use for such beats because of our peculiarly strategic positios. However, in 1996, it was felt that we should see for ourselves whether the

Doing Business In 35 Languages

by Westinghouse



- To youngsters or oldsters whose hobby is collecting stamps, the incoming mail department of our export company would very likely prove a paradise.
- A single day's mail will bring letters from as many as twenty-five countries. In the course of a year, correspondence is received from practically every country in the world, and it has traveled to us by every conceivable mode of transportation from Tibetan runner to air express. It may be penned in anything from a Chinese ideographic script to just plain American English. More than thirty-five different languages will find their way in and out of the mail basket.
- No doubt you have heard many men say that their business "is different." But rarely will you find a business right here in our own country that is as really different as that of our people whose responsibility lies in the shipment and sale of our products abroad.
- Most of these men have spent years in the field, in Buenos Aires, Singapore, London, Cape Town.
 They have sold our products in Spanish, French, Portuguese, Swedish and even more remote tongues.

- They have learned to make change in lira, pesos and shillings as simply as you and I count our change from a dollar bill.
- During the past two years we have run an advertising campaign in 95 newspapers in 41 countries. Each advertisement is translated into 7 different languages. 25 entirely different currencies are used to pay for the newspaper space.
- Climate also plays an important part in the distribution of on products throughout the world. For instance, a radio set which is perfectly suitable for sale in the United States must be specially designed and treated to stand up under tropical humidities before it is acceptical but of the countries near the equator.
- Another product problem is that of electric voltage and frequency.
 Here in the United States 110 volt 60 cycle current is standard almost everywhere, but in export territories these voltages range anywhere from 90 to 380 volts, and from 16% to 133 cycles
- Add to these problems the complications of the present world strife. But business goes on as ever, and our export people insist that theirs is the most interesting business in the world.
- All of the products that we make, from the grain of wheat lump for doctors to immense turbines for power companies, find their way to the farthest reaches of the globe. American products find a ready marketabroad. And the fact that these products sell as thigher prices in competition with those locally manufactured is a tribute to American craftsmanship and salesmanship.

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Lead Electro Metallurgy, I C S	6 50	1 25
Leather Manufacture, Wisson	7 50	2 50
Line Charts for Engineers, Rose	3 00	1 00
Lubricants American Lockhart	5 00	2 00
Metallic Objects, Electrolytically, Planhauer Metallicraphy, Structural, Plany Plany Metallicraphy, Structural, Plany Plany Metallic Structural, Plany Metallic Structural, Plany Metallic Structural, Structural Metallic Structural, Metallic Structural, Metallic Structural, Metallic Structural, Metallic Structural, Metallic Metallic Structural, Metallic Structural, Metallic Metallic Structural, Metallic Metallic Structural, Metallic	1 50 5 00 6 00 5 00 2 50 1 00 3 00 5 00	76 2 00 3 00 1 50 1 25 50 1 00 2 00
Natural Terpenes, Baker & Anderson	2 50	1 25
Nitroglycerines & Nitroglycerine Explosives, Naoum	7 50	2 50
Notes on Chemical Analysis Craig	2 50	1 25
Oil Salesman's Primer, Ettale	3 00	1 50
Organic Chemistry, Noyes	4 00	2 00
Parachor & Valency, Nagden Phymical Chemistry, Exp. 1 on Klooster Phymical & Collond Chemistry, Michaeles Plumbing Design, Nagry Proceedings of the American Gas Institute, Part I, Proceedings of the American Gas Institute, Part II,	4 00 3 50 2 00 6 00 5 00 5 00	2 00 1 00 1 00 2 50 2 50 2 50
Qualitative Analysis, Mason Quantitative Analysis, Bassett	1 00 4 00	2 00
Rainmaking, Humphreys	2 00	1 00
Reinforced Concrete in Burope, Colby	3 50	1 00
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Research Narratives, Fisan, Vol II	1 00	50
Sales Technique I (S	6 50	1 25
Sparking of Steel, Paint-Gar	2 00	.85
Theory of Brownian Movement, Esnsiess	175	75
Thermionic Phenomena, Block	280	1 25
Waterworks Practice, Modern Taylor	5 00	2 50
Wood, Lumber & Timber, Hayword	10 00	3 00
Works of Geber, Russell	2 00	.75

(To above prices add 10c for postage for each book)

QUANTITIES LIMITED-ACT QUICKLY

For sale by SCIENTIFIC AMERICAN, 24 West 40th Street, New York, N. Y.

type had possibilities, and \$15,000,000 were appropriated for experimental purposes. A design competition was held, and the Navy Department began a building program which included four 59 foot and four 81-foot motor torpedo boats plus several submarine chasers. All off these boats should be running by the end of summer.

To check our own developments, the Navy ordered a motor torpedo boat of a design by Hubert Scott-Paine, from Elco, Scott-Paine's sole beensee in this country. It was delivered in the United States in September, 1939 At that point, it became evident that it would be months before the best American type could be selected for reproduction, and the Secretary of the Navy falt that the strained international situation was such that no unavoidable delay was acceptable in the matter of commencing tactical training and experimentation, and was a British design that had been actually proved, was reasonably good, and could be reproduced in numbers. So he at once placed an order for 23 more of the Scott-Paine design from Elco

Purchase of such a number in one lot assures an immediate and homogeneous fieter in being suthout waiting until the best American design could be selected and then duplicated. Mr. Edison felt that it was sittal to start work with such a homogeneous fiete, and determined to speed up the development of the strategic and tactical use of the type.

While all those concerned with procurment of these loots, of a type new to the United States. Navy, are interested prinarily from a technical standpoint, they also look upon the present attuation as a fine sporting event. Everone is looking forward to the day when the American boats will test their worth, bears to lead, with the standard of the control of the will be the standard of the control of the will be the standard of the control of the Navi is impossing on the new look that the

PHOTO-TUBE MEASURES ULTRA-VIOLET

A "BUBBLE" window, 0 002 of an inch thick, and a sodium cathode have been incorporated by scientists of the General Electric Research Laboratory at Schenec tady in the new photo-tube shown in our



In hand: U.V measuring tube

illustration. It has a maximum response at a wavelength of ahout 2500 Angstrom units in the invisible ultra-violet spectrum and a very small response to visible radiation.

It is made of a special ultra-violet transmitting glass and replaces a more expensive tube in a quartz bilb. Mercury vapor detection and the measurement of ultra-violet output of low-pressure mercury germicidal lamps are among its applications.

ILLUMINATED SHOP

To the Flash-O-Lens which was described In in these pages some months ago as a useful magnifying glass with a self-contained light, there has been added a microscope to increase it is magnifying power. The original device gave a magnification up to seven powers, whereas in the new Flash O Lens with the Bausch & Lond shop micro-



scope, the power has been extended to 40 times. The shop microscope has an engraved scale mounted in the body tubewhich reads direct to thousandths of an inch, and estimations can easily be made to 00025 of an inch.

This new device, which is shown in an accompanying illustration, may find wide use in routine inspections of product and process equipment. With it may be examined cracks, flaws, surface bisters, half-tones, color process plates, textiles, paper surfaces, and the like. It is made by E. W. Pike and Company

GLASS CHALKBOARD IN COLORS

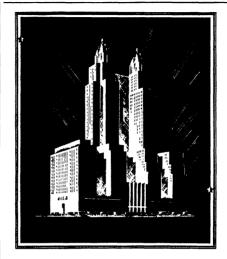
A NEW chalkboard or blackboard for schoolroom and home use, manufactured from a specially treated plate glass, was announced recently by the Pittsburgh Plate Glass Company.

The new chalkboard, called Nucite, is being produced in three standard colors vory, green, and black - in order to give school decorators more leeway in working out color and lighting schemes. Dark chalk is used on the ivory colored "board" and light chalk on the green and black products

The development of Nucite, according to W. O. Lytle, secretary of Central Research of the Pittsburgh Plate Glass Company, was the result of an effort to provide a very durable chalkboard that would lessen eye strain of children of school age.

Nucite has less glare and its lighter colors can be used to advantage in better illumnation of school rooms. Tests show that Nucite is an important contribution toward the protection of the cycsight of school children.

In addition to the reduction of eye strain, the variety of colors in which Nucite is available permits the adoption of more pleas-



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Its towers, sharply etched against the sky, are modern as tomorrow...yet its tradition of hospitality goes back to a grand and spacious age.

Its glamorous restaurants, favorite gathering-places of metropolitan society, are vibrant with music and gaiety... while above, its rooms are star-quiet in the night, peaceful as the hills of home.

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An Accurate Balance at a Price Within the Reach of All



Sensitive to 2/50 gram
Weighs up to 100 grams
Compact—No loose parts
Modern, durable construction
Small convenient size

Handsome streamline design Now permissible for auxiliary use in drug stores (N. Y. C. Serial B17.)

Never before a balance with all these exceptional features!

Finest Quality—Made of tested materials Its construction will appear to laboratorie desiring the best equipment. The Baskelite cup is unaffected by practically any substance that can come in contact with it the tool steel knife edge and agate bearing will give long life and accuracy.

Retained Scientificity—Weighs to one decimal point farther than the usual low-priced counter scales and serves nearly every laboratory purpose short of precise analysis. The capacity of 100 grams is ample for the delicate

weighings made in the usual course of teaching organic synthesis, experimental work, compounding, photographic work, etc. Compact Convenient—Does not monopolise a laboratory table Placed on the desk of the busy technical executive, it will soon become indispensable.

Its small size makes it possible to carry it on inspection and testing trips at a distance from the laboratory. It is small enough to be carried under the arm or in an overcoal.

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The new battery is similar to the standard type of lantern battery both in appearance.



Interior view of new battery that does not deteriorate. Inactive cells surround a glass vial which is shattered by striking bottom of can

Right An emergency truck flare using the battery shown above. Other forms of lamps using these

using these batteries are designed for emergency lights

lights at airports, in subways and mines, and so on



method of contact, and voltage capacity. The main difference is that the cells are packed and sealed in a dry state and activated only when the bottom of the battery is struck against any solid object.

Units are made up of four cells connected in series. Cell are made up of carbon and me smiles to ordinary dry cells, except that the activating liquid or electrolyte has not been added, which is the factor that makes them non-deteriorating on shell life. When the glass or wal as broken, this liquid activates them and then they are in every respect identical to ordinary dry cells. The cells and vial of activating fluid or electrolyte are un as made and vial of activating fluid or electrolyte are:

These lights are designed for emergency use in subways, mines, on aviation runways, trucks, and other motor vehicles, railroads, boats, in hospitals, and for military and marine use.

COLORS BRASS BLUE

A BLUE color can be obtained on brass by using a solution of sodium thiosulfate and lead acetate, according to Copper Alloy Bulletin. Suggested quantities are 124 grams of thiosulfate and 38 grams of acetate

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for each liter of solution. The thiosulfate and the acetate are dissolved separately, each in a half-liter of water, and the two solutions are mixed just before use Temperature of the bath should be about 60 degrees, Centigrade A yellow-gold color is produced first and is followed by the blue in about one half minute.

INSULATION

N placing wall insulation, it might e well to consider the statement of P. D. Close, of the Insulation Board Institute, the gist of which was that the first inch of insulation equals in effectiveness the next 20 inches.

FLUORESCENT PAINTS IN COLORS

NEW series of 12 light-emitting paints A have just been announced by Continental Lithograph Corp By ordinary light these colors have the appearance of ordinary colored lacquers, with perhaps an apparent fluorescent quality, but under the invisible glow of so-called "black light" (ultra-violet) the colors all come alive and glow in a fiery sort of beauty. The "black light," which is harmless, is generated in simple black bulbs which may now be purchased for as low as \$2 each

The Conti-Glo lacquer-enamels have nu merous decorative uses. They are being applied in theaters for striking effects, in murals in restaurants and other public buildings, and may indeed find use in carry. ing out design schemes in homes

"INSTANT HEAT" SOLDERER

NEW electric solderer recommended A for all kinds of light soldering is announced by the Ideal Commutator Dresser Company Called the "Instant Heat" because it heats instantly upon touching the wire or terminal to be soldered, this tool is hardly larger than a lead pencil and easily solders in hard to-get-at places

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BROTHER-SISTER MARRIAGE

Discussion of the case in Indianapolis where a girl is reported to have marined her own brother without knowledge of their kinahip revives an old question. If a scientist in the field of human heredity were asked to decide the question, "Should brother and sister marry," he would probably answer, "Well, that depends."

ignoring for the moment all questions of law, custom, and religious taboo, and considering only the biological interest of possible children to the marriage, the geneticist would want to examine the history of the family.

If weaknesses, either physical or mental, have "run in the family," then the child of a brother-siter marriage runs a very much more than double risk of inheriting such weaknesses If, on the other hand, the family is "good stock "with many destrable traits, the child of such close intermarriage has a strong chance of receiving a valuable inheritance.

The facts hold true, although in lesser degree, of the marriage of cousins

degree, of the marriage of cousins. Among the animals lower than man, mating of sister to brother is common practice and is not frowned upon by biologists. On the contrary, it is the method selected for building up traits most desired in future generations. Man, although surrounded by complex social restrictions, is still an animal in matters of heredity.

But the labor against brother-sister marrage is pretty general in all fuman societies as it is in our vestera evaluation today. Brother-sister marrages were encouraged in ancient times among royally in Egypt. Pera, and Hawin, but even there the common people were bound by the same taleon on the companies of the companies of the comton the companies of the comton places. In the companies of the comton places, the comton places are the comton places and differted places are the comton places. In the comton places are the comton places are the comton places are the comton places. In the comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places. The comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comton places are the comton places are the comton places. The comton places are the comparation places are the comton pla

Yet brother-auter unions have always socurred regardless of takoos, among evihard as well as among primitive peoples. This has led Dr. John M. Cooper, anthropologist of the Catholic University of America, who has made a special study of incest among has made a special study of incest among nothing instinctive about the reluctance of brother to marry sister. It is, he believes, purely a socially-imposed restriction. — Science Series.

COMBINED ENGRAVER AND ELECTRIC ETCHER

A NEW bench-type pantographic mawork on all materials, and electric etching on soft or hardened steel, has been introduced by H P. Preu Engraving Machine Company. Separate heads, quickly interchangeable, are used for the two classes of work.

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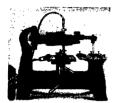


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AT THEIR POSTS

RELIEVED to be the first time so many employees have been reached at one time without leaving their jobs, Pontisc workmen recently were addressed by William S Knudsen, president of General Motors. The talk was made over a public address system and loudspeakers throughout the plant, the first installation of its kind

VESSELS OF MANY SKINS

THE continual increase in the pressures used in industry for gas storage, gas separation, hydraulic presses, high temperature hydrogenation, and many chemical syntheses has required an equivalent increase in strength of the vessels which are used for the processing, says the Industrial Bulletin of Arthur D Little, Inc. Equipment manufacturers have found that the problem could best be solved by a change in construction principle, rather than by a simple increase in the thickness of the walls of the vessel.

One promising development is the multilayer vessel constructed essentially by wrapping several thin-walled vessels around each other until the required wall thickness is attained. These vessels are now rather common and one has been successfully operated at high pressures since 1931. On service testing these vessels to destruction, the designers found that when a break finally occurred it was by stretching and deforming, rather than by explosive shattering One explanation of the success of the multi-layer

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construction is that hidden flaws in the metal or the welding are confined to one layer so that a break in one layer is not followed by an immediate break in the entire

As pointed out in a recent article in Chemical and Metallurgical Engineering, multi layer construction is advantageous not only in strength but also in economy and flexibility of production. As always with advances in equipment design, chemical engineers are already anticipating the process improvements these vessels will permit

EYE MUSCLE EXERCISER

Y/EAK, lazy, and inefficient eyes may be exercised with a new and versatile small-size metronoscope developed by the American Optical Company This device does two important things it aids in training one to read more efficiently and at the



. . . trains and reconditions eves"

same time exercises weak and lazy eve muscles which do not function together The metronoscope has three shutters in front which open and close in sequence. exposing a third of a line of words printed on a reading roll. The patient sitting before the instrument and looking through special lenses (prisms) is forced to read correctly, for the operation of the instrument does not permit long pauses or any retracings of matter that has gone before In addition, the reading roll can be speeded up, thereby training the subject by degrees to increase his reading speed. Such enforced reading trains and reconditions the

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the intensity of the rays, the walls and ceiling are lined with sheets of aluminum-bronze. Through the length of the room runs a gangway between guard rails, along which the sun-bathers slowly walk. The workers use the solarium about every second day in the winter, each treatment lasting only two to three minutes, a period regarded as sufficient to provide the body with the needed amount of "sunshine."

The beneficial effects of this innovation have been clearly demonstrated in a questionnaire, which the company recently circulated among its workers Eighty-four percent of the employees reported that they were less troubled with colds than before, while some even testified that they had conquered this ailment completely. In other cases muscular aches and fatigue have been eliminated, and the number of fractures reduced In general, the sun bathers claim that they enjoy a much sounder sleep since they began the lamp treatments. In addition, statistics for the winter 1937 1938 show that 175 workers had 78 fewer days off for sickness than during the dark season of the preceding years. The working capacity of each individual who uses the solarium regularly also has increased.

Boliden has long been a pioneer in means and measures for improving the health and working conditions of its employees. It is now reported that many other Swedish industrial concerns, especially those located close to the Arctic Circle, will install similar solariums in their factories -Holger Lundbergh

POWERFIL MAGNET

ASSEMBLY

NEW permanent magnet assembly, A NEW permanent magnet as any roughly three times as strong as any previously known, was disclosed recently by the General Electric Research Laboratory It permits a tiny piece of sintered alnico to lift and hold 4450 times its own weight.

The previous record assembly, developed in the laboratory last year, allowed a piece of the same material to lift 1500 times its own weight. Sintered alnico is an alloy of aluminum, nickel, and iron as the basic or essential ingredients, and is made by pressing together the powdered metals and heat-



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The multi-gap magnet assembly

ing almost to the melting point. By itself, without the special assembly, an almoo magnet has a normal lifting power of 500 times its own weight

A new mounting of brass and non in which the magnetic flux passes through many air gaps, instead of the usual two, in bridging from pole to pole, is responsible for the greatly increased power. The new assembly is not a commercial development and the larget struend out in the laborators to date contains but three cubic centimeters of alinco.

Though smaller than a thimble and weighing three fourths of an ounce, this magnet in its mounting has supported as much as 200 pounds in tests

SULFITE

SULFITE liquor remaining after the cellulose is removed from wood pulp is not only an unmarting material but is also troublesome because it kills plant life and fish. Yet from this unpleasant material is made sweet smelling vanillin, the basic constituent of vanilla extract, while the remaining liquor is used to make lignin plastics.

NEW BIRD

DISTINCTLY surprising is the fact that despite our vasured complete knowledge of every aspect of our country, an entirely new bird species has just been discovered. It is the first new species of burd to be discovered in the continental United States in 21 years and was found in the "panhandle" district of West Virginia by Karl W Haller, our thologist of Betham College.

EYES THAT SHINE IN THE DARK

THE strange light that "shines" from the eyes of cats and other animals at might has been investigated for the first time by Ernest P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution.

It must be a reflection from some surface of the eye of the light that shines upon it, Mr. Walker reports in the annual Smithsonian yearbook.

Mr Walker carried out his investigation in the zoo with flashlights, aided by zoo policemen making regular rounds. While the shining of eyes is a well-known phenomenon Mr. Walker points out in his report, most of the observations have been



made in the wild. The owner of the eyes is frequently unknown, and it is usually impossible to observe the same individual again under similar circumstances.

His best results, Mr Walker reports, were obtained with light of moderate intensity. If the light is too bright the shining is less conspicuous, or does not appear

The "shines" range in color from pale

silvery through silver, blue green, pale gold, gold, reddish gold, brown, amber, to pink, with a wide range in intensity from dull to very brilliant

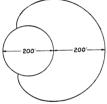
Mr. Walker experimented with the effects of red and blue light on the "eyeshine" color of 40 species of mammals and reptiles, but he found little variation in colors of the reflected light, other than the expected red and blue tuges.

SECOND CIRCULAR

PASTURE PROBLEM

READERS who have been addicted to lan's mathematical problems will recall that, in his first, published last September, a cow was tethered made a circular pasture 200 feet in diameter. This time our bovine mathematican is tied outside the same eaclosure, and thus has a new problem on her mind.

A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200



feet long to a point on the fence, and outside the enclosure. Over what area will the cowbe able to graze?

Commander Kaplan suggests that the answer be published in advance, and it is 89,968 52 square feet. The solution, which is, of course, what chiefly interests the mathematician, will be published in the next number. In the meantime, send your own solutions, also any communications regarding the published in the meantime, send your own solutions, also any communications regarding the published in the meantime, and the send of the send o

Readers who have been working on this series of problems may be interested to learn that Commander Kaplan is the Ship Superintendent in charge of the actual construction of the North Carolina, first of the new 35,000-ton battleships of the Navy's new building program, which will be launched in June or July. The mathematical problems represent one of his outside hobbies.

SOLUTION TO THE PROBLEM OF THE MEDIANS

Last month's problem was as follows: Construct by graphical means the triangle whose medians are 1.8", 2.4", and 3.6". Compute the lengths of the three sides of the triangle so constructed.

The solution: First, construct a triangle whose three sides are respectively equal to two thirds of the lengths of the medians. For the problem given, this will be a triangle whose sules are 1.2", 1.6", and 2.4". Draw any one of the medians of this triangle—the one to the 2.4" side, say—and produce it its own length c/2, as shown. Extend the side of the construction triangle-to which the median was drawn its own length (2.4") in either direction. Connect the point so laid off with the extremittes of the median produced, and the resultant triangle (de-



noted as having sides a, b, and c) will be the one whose medians are 18", 24", and 36". Proof of the construction follows from the theorem that the medians of a triangle intersect at a common point, which trisects

each median. Since 16" completes the triangle, whose other two sides and the included angle are 12'' \in '2, and θ respectively, we may write the following relation.

(16)* = (12)* +
$$\left(\frac{1}{2}\right)^2$$

= (2) (12) $\frac{r}{2}\cos\theta$ (1)

and similarly, for the triangle where 12" is the side opposite the angle φ included between c 2 and 12".

$$(12)^2 = (12)^4 + \left(\frac{e}{2}\right)^2 - (2)(12)\left(\frac{e}{2}\right)\cos\varphi \tag{2}$$

Adding (1) and (2) gives $(16)^3 + (12)^3 = 2(12)^4 + 2\left(\frac{c}{2}\right)^2$ (3) from which, $c^3 = 2.24$

c = 1 49666"

We may solve for the other two sides in the same way. They evaluate to

$$a = \sqrt{11.84} = 3.14093$$
"
 $b = \sqrt{15.20} = 3.89872$ "

A second method of graphical solution is shown in the second sketch. Here, the first step is to construct the triangle of the me



dans—the trangle, that is, whose sides are 18°, 24°, and 56°. Next, lay off progressavely—from left to right, sav—two thrifds the length of each of the stave of the tranagle. The triangle connectung these points will be similar to and will have sides one balf those of the triangle deared. The latter can be produced graphically by drawing through each vertex of the half scale trinamle parallel to the side consorting.



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YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use Hence this monthly denortment presenting a wide variety of discussion regarding frearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.—The Edinom readers will be heartily welcomed.—The Edinom

"CAVIAR" GUNS, AND

THE fine art of engraving on gun is a land as a flaram threadere, but modern engravers are and to surpass the 16th Century artsass in skill, magnation, and execution. Since the days of Smon and Petro Marcatte and Albrecht Durer, tools of the trade have improved a thousand fold, which no doubt accounts in large measure for present-day excellence artistry Despite endorsement of the Marcarte brothers' art by Holy Roman Emperor, Charles V, the appointment of Petro Marcatte as Royal Arquebusser to Charles II of Span, and notwithstanding Durer's unimprachable reputation as painter and engraver, the petuter of the late 17th Century



From the 17th Century

Italian-made finitlock, reproduced here, indicates that although European guinamith had by then plied their trade more than 200 years, the decorative art and its delineation was crude, unimaginative, and lacking in prespective and depth, as compared with the modern work of Joseph Fugger, for example.

The infancy period of firearms history might be termed the "Age of Caviar and Kippered Herring," for the ornate and inlay work, which often covered the entire weapon, meant as much to the medieval huntsman as the utility of the piece and so increased its costs as to prohibit ownership by any save kings and noblemen. If the medieval vassal owned a gun at all, it was a plain, simple affair with shooting proclivities probably on a par with that of his feudal lord and master, but it was conspicuous for the absence of designs and decorative effects. Today, while the taste for "caviar" guns has improved and in-creased, rather than diminished, the "kip-pered herring" class of firearms is being served up with a bit of toast, so to speak, and, to carry the fancy further, frequently with butter and a garnish of parsley.

But this doesn't mean that the cost of beautiful engraving has decreased, as indicated by the price for a truly amazing and intreate pattern of relief work in gold and silver on a Smith & Wesson revolver, recently completed by the firm of Griffin &



In gold and silver

Howe, New York. The job required almost a year of working hours on the part of Joseph Fugger, Griffin & Howe's acengraver. While the piece is considered by S. R. Griffin to be one of the finest ever turned out in the 17 years his from has been in housies, the constant flow of orders for finesting the properties of the properties of the finesting decision from all parts of the communication of the properties of the properties of which keep Joe Fugger to the same weapon for 1000 to 150 hours.

The name of Rudolph John Kornhards will be familiar to many owners of beautifully engraved guns, for during his hey-day he was acknowledged as America's No. 1 firearms engraver, and it was Kornbrath who entited Fugger to this country after the latter had completed a four-year course engraving in his native Natira. Kornbrath, an earlier graduate of the same Austrana school, took the younger man into his shop in Hartford 16 years ago as appendice. From there he went to Griffin & Howe, for whom Kornbrath had frequently done special work Todday, Fugger, whose father before him was a noted Austrana gunnatul, is the acknowledged suc-



Of the 20th Contury



Hands that do the work

essor to the master, Kornbrath, who has been forced into retirement by ill health.

Fugger, according to S. R. Griffin, is typical of the skilled artisans who are products of English, Austrian, Belgian, Swedish, and German training in gunsmithing Contrary to American mass production methods of firearms-necessary to supply our 8 million licensed hunters—the Europeans still adhere to the "custom made" theory of sporting gun manufacturing to a greater extent



Machine manipulated

than do we. Because of the high quality of workmanship demanded by his clients, Griffin, therefore, has found it advisable to staff his shop entirely with European trained workmen, all of whom, incidentally, are naturalized American citizens.

However, this is no distribe against our own firearms manufacturers, whose inventive genius, perspicacity, and business acumen are responsible for more improvements in firearms since America's cradle days than all the rest of the world put together. As stated above, mass production in the U. S. A. is necessary to supply the demand, and the fact that our manufacturers have not only accomplished that, but also have incorporated in their products many refinements and niceties found in European "tailor-made" guns, speaks volumes. It took American ingenuity to find methods of serving up the "kippered-herring" gun with "toast, butter, and parsley. And just so we won't be misunderstood, our personal gun rack contains an \$8.95 single barrel, 16-gage shotgun which has accompanied us through numerous vicissi-tudes, and if you don't think it's valued highly, try to get it out of our den.

Typical of American efforts to enhance

medium priced shotguns is the newly perfected electric etching process of the J. Stevens Arms Company. Machine manipulated, and directed in accordance with the lines of a pre-determined master pattern. this process produces in exact detail on gun receivers any scene depicted in the tion of this etching process remains a secret, it can be told that the method provides a means of making changes in the pattern at very reasonable cost so that the same scene or decoration need not appear on all preducts A further variation exists in image in relief.

Of course, kippered herring may never hope to attain to the status of caviar, and it hasn't been our intention in this column to intimate that we think all shotguns or rifles are the same under their etchings There are just as many differences between the well made, straight-shooting, \$9 single barrel (like our's) and the magnificently constructed \$1000 piece (which we don't own!), as there are between any other manufactured products with a wide price variance. The point is that, under the American system, those of us who have "kippered herring" incomes can shoot just as well and have just as much fun shooting as anyone else.

Pot-Shots

AT THINGS NEW



THE DAIRY SPECIALTIES, INC., announce the "Ferret" shotgun cleaner, made to fit any standard cleaning rod and all gun gages. Composed of a bronze alloy wire, soft enough to prevent gun-barrel injury, yet hard enough to remove rust, lead, other deposits, the "Ferret" is

tapered at both ends to permit passing through choke in both directions, on rod or stout cord, and is self-sharpening, working even better after being used a few times. It sells for 65 cents.

BOOKS OF THE MOMENT include "A Handbook of Salt Water Fishing," by O. H. P. "Ollie") Rodman, Editor of "Hunting and Fishing," and "Mastering the Rifle," by Morris Fisher, National, International and Olympic Champion.

THE POLY-CHOKE COMPANY offers for 1940. in addition to their well-accepted device for producing nine different degrees of choke on automatic or repeater shotguns, the "Aero-Dyne" Super Poly-Choke, especially adapted to the new, crimp-top shells. The new product produces a more open pattern than the regulation wide-open bore and is available for 12, 16, and 20 gage shotguns. All Poly-Choke products are de-scribed in new, free booklet, "How to Become a Better Wing Shot."

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LIGHTING GOES MINIATURE

THE ability to create special lighting effects with equipment that can be handled with ease in the average home and has, in addition, the advantage of portability, is something that most serious photographic workers desire. The selective lighting so characteristic of spothjatis as vacceful ventures in this connection have been undertaken by enterprising manufactures to bring to amateur as well as professional workers, so-called "ministure spotiestist" that, in our opmono, provide all the



Figure 1



Figure 2

lighting facilities necessary for many types of pictures, whether "straight" or otherwise.

Those at present available are usually equipped with a Frend-lens, which gives a soft outline to the spot, a small propertion bulb corrected to 3200 degrees, Kelvin, the temperature required for color work, a control lever for varrung the size of the projected beam, adjustability of the light may angle, and a base that can either be set on a table, floor, or similar support, served into a tripod head or, by the use of an accessors adapter, attached to a regular light stand.

Among the miniature spotlights now available, or won to come on the market, are the Dinky linke, now being used extensively in Hollywood studios for special portrait effects, the F-R H Spot, and the Lafayette Hi-Lite Another type of miniature spoilight is the Willo Spotlight which uses a Photoflood bulb and a condensing lens to provide a small briefs too!

Among the uses for which this type of equipment seems particularly adapted, there at once come to mind still lifes, tabletops, and portraits By controlling the beam, either through close approach to the subject, the use of a "snoot" as on the Dinky-



Figure 3

Inkie, or varying the distance between the spotlight lens and the bulb, one may illuminate small areas and thus place light emphasis where it belongs

The versatility possible with these ministure spollights, when equipped with diffuser and snoot, is demonstrated in the result shown in Figure 1, which was lighted with two Dinky-Inkies. One unit was placed in front, near the camera, with diffusing screen before the lens, while the other, equipped



Figure 4

with a small diameter moot, was set at an angle to the subject. The result shows a definite spotlight effect on the selected area (the face), with shadows filled in hy the front diffused hight. These snoots are asalable in armous diameters. In addition, one may obtain a set of "barn diors" or blinkers to keep hight away from invanted areas of the subject matter. Figure 2 illustranted areas of the subject matter, and the subject as shown in Figure.

These spoulphs are a particular joy to the tabletoper and those vorkers sho take a delight in still life photography. Figure 4 shows an FR He/Spot in use on a tabletop subject. The ease with which those lights can be handled is obvious to anyone who has had experience with larger equinent. Because of their small size, they may be placed in out-of-the-way corner, even helm of the subject, and a till sorts of

To provide a general light, the lens may either he fronted with a diffusing screen or where a stronger light is wanted, the lens may be removed entirely and the bulb moved forward as far as it will go A sur prisingly large area can be covered in this This all-round usefulness of the way miniature spotlights brings the suggestion that one might assemble a complete lighting outfit by using three miniature spot lights, provided with three light-weight stands. For these, a fiber case might be made to house the entire equipment. Such a combination, with its extreme portability, would not only allow the worker quickly to assemble or dismantle his lighting equip ment for storing in a closet, but would also permit taking the whole affair to distant scenes of picture-making

A New Profession

COMMENTING on the searcity of photographers who at the same turne have a background of scennife training in a special field, Partifield Osburn, Secretary of the New York Zoological Society, proposed a new profession at a recent conference on Photography, held in New York, City under the suspices of the Institute of Women's Professional Relations, Connecti City under the suspices of the Institute of Women's Professional Relations, Connectic City under the suspices of the Institute of women's Professional Relations, Connectic City under the suspices of the Institute of women's Professional Relations, Connectic training in motion pictures or still photography, towards the end of achieving the ability to interpret scence for the layman.

The man who "knows his stuff" is always in demand and the photographer who has a good knowledge of the subject he is photographing, and therefore interpreting, is hard to find As an example, Mr Odorn pointed to the fact that for some time his organization has been looking for a good motion-picture photographer who had also had a good training in noology, and that so far the search had been in value.

Colonel Edward Stachen, the photographic ace of our time, addressing the same group, referred to photography a "the universal medium of expression" entiating between the amateur and the profeesional. Colonel Steichen said that the amateur, even though he may sell a photograph now and then, may still keep his amateur status because he works only as the mood moves him, whereas the commer cial photographer must turn out pictures as and when ordered. The news photographer, he added, has a still harder job because, although the commercial photographer, even though working against a deadline may have opportunity to shoot 50 or 100 negatives, the news photographer must bring it all in on one plate

Speaking of the hinancial reward in photography, Colond Steichen said that if a man or woman goes into the field with the idea of making a lot of money, hor she had better forget about it right away. All the acts in photography, he said, started off with the diea of turning out a good picture, but not to make money. That they also made money was incidental.

We should like to comment here that while the photographic field is overcrowded, as Colonel Steichen said, so is many another field, but for the person with superior ability and a new idea, there is always room in any field, and that includes photography

In our next issue, we plan to give a resume of the various talks given during the Conference, in which speakers from many different fields outlined the opportunities for photographic careers.

PRIZE WINNERS

PRIZE winners in three amateur photographic contests have been announced since our last issue. These took top place in the Raygram Corporation's Ray Del Developer Contest, the third annual Kalart speed Flash Competition, and the Packard Amateur Photo Contest

The first contest, which called for pho



First Prize: Field



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RETTER PICTURES

fundamental requirements. Once you find out how your camera works, learn how to make correct exposures, and master the basis of composition, your camera results will show immediate improvement. For memory of the Want to Take Butter Pictures," the author, drawing on a versied experience in photography, has packed put the things you need to know. Questions and problems have been anticipated, answered in detail, for the camera owner who has ha developing and printing done at the photo shops. Written as a running stroy of your camera and how best to use it.

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Second Prize: Steinmets

tographs illustrating the idea of balance, and made from negatives developed in Ray-Del, was judged by Willard D Morgan, Kip Ross, and Herbert C. McKay. Prize winners were Nathaniel Field, Brooklyn, New York, who took first prize of \$50, Joseph Janney Steinmetz, Philadelphia, Pennsylvania, second prize of \$25, and Edmund Janke, Jr., Middletown, Connecticut, third prize, Nine others received honorable mention and cash awards of \$5 each

Twenty-five entries, representing practiwon cash prizes totaling \$250 in the third annual Kalart contest. More than 2000 prints were received, a 130 percent increase over last year's contest. Subjects ranged from the familiar child pictures to spinning gyroscopes.

Murray Hoffstein, of New York City, employing a recently purchased Automatic Rolleiflex, took first prize in the Packard Amateur Photo Contest. The picture he



Packard winner

made and the car he won are both shown in the accompanying illustration. Shortly after the judging was completed and the winners were announced, Mr. Hoffstein rolled away in his new "One-Ten" Packard convertible coupe. The judges found the the illustrative angles.

NEW SOLAR MODELS

MPROVED models of the Solar enlarger are now available possessing a number of features designed to make them adaptable to various uses other than straight enlarging. The enlarger, which comes in three models covering all negative sizes from 35mm to 21/4 by 31/4 inches, now permits easy adjustment of the equipment for verFIFTH ANNUAL SCIENTIFIC AMERICAN

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tical or horizontal projection; for use as a copy stand, employing your own camera; for straight photography and photomicrog-raphy, and other needs. Lenses and lenboards are interchangeable, and the lamp house may be used as a lighting unit in tabletop and similar work.

Hypo CAUTION

ORDINARILY, the mixing of a hypo solution is by no means a critical proposition. However, if—through neglect or through some notion that, by making the hypo bath stronger, fixing will be more rapid or more effective—the formula is not followed, it will sometimes be found that the strong hypo solution will tend to bleach the image

WE MAKE THE MILLIONTH

DIFE nearest we shall ever get to a milhon of anything is reported in a story in the Kansas City Star announcing that our recent book, "Finding New Subjects for Your Camera," was the 1.000,000th book added to the Kansas City Public Library The event was marked by the publication of a picture showing a library staff member stamping the number in the book. The story adds that the book arrived 66 yearto the month from the beginning of the public library and that the book which had been numbered 1, "The American Cyclopedia," was long since worn out and dis-

carded The library, the story adds, possesses more than 100 titles on photography and, as indicative of interest in the field, the file cards are soiled with thumb marks

"We can't find enough books on the subiect," said Louis Nourse, the librarian

METAL ALLOY FOR SINKS

W/HAT'S good enough for the professional is good enough for the amateur photographer. One of these is a metal known as Inconel, 80 percent no kel and 20 percent chromium. If you are looking about for a metal darkroom sink that will with stand the corrosive tendency of photographic solutions, we would suggest your investigating Inconel We have been advised that it "stops fogging, metallic con tamination, corrosion, chipping, cracking, and rusting," and that as a result it is being used extensively in the processing of motion-picture film, as well as in some large photo-finishing plants Also, pho-tographic trays made of this metal are available in various sizes.

ENLARGER PRICES DOWN

PRICE reductions on all models of the Praxidos and Bee Bee Enlargers are announced by the distributors, Burleigh Brooks, Inc The prices have been cut as much as 42 percent in some cases.

STOLEN CAMERAS

THE wave of camera thieving goes on space. Every once in a while we hear about another member of the photographic fraternity whose studio or home has been broken into by thieves and robbed of expensive cameras and equipment. Recently,



Begin today making a thrilling movie record of yaw family, your hobbies, and yaw family, your hobbies, and yaw family, your hobbies, and yaw family how fa Filmo is a basic camera to which you may add accessories as your skill grows Only \$49 50. Other models to \$1155—easy terms.







the threves have made several large "hauls". These losses are seldom recovered and when they are it is usually in a pawnshop. With threves guanning for cameras and

With theees gunning for cameras and equipment, every owner of cameras having reasonably high value should guard his equipment by using strong locks, never leaving the equipment cardessly about and, alowe all, taking out camera insurance If mostred, at least you have the feeling that your camera is protected—even against your own oversights!

COLD LIGHT IN DARKBOOM

WITH fluorescent lighting as one of the big features of the day, the introduction of a new type cularging lamp that employs a fluorescent gaseous discharge tube makes interesting news. The unit, known as the Princeton Fluorescent Enlarg



ing Lamp, comes equipped with a light qualizing screen and is no more trouble to install in the enlarger housing than the ordinary light bulb. The makers claim that the unit is "so cold that it can be held in the hand after ten hours continuous operation with no discomfort whatsoever."

The unit produces white light "extremely close to daylight in its color characteristics." It is reported that the unit "provides a soft, white light evenly diffused, which gives a peculiarly fine print quality which combines tonal gradation with true brilliance."

Using alternating current only, the unit has a minimum life of 2000 hours. It consists of a small metal housing 4 inches high and 3%, unches in diameter, fitted with a standard series plug that fits the socket of the enlarger. The light may be used for all negatives from 35mm up to 3½ h 3½ inches. The unit is adjusted so that the diffusing screen is close to the upper condenser face.

PRINTING HARSH NEGATIVES

THE best way to correct harsh negatives in to make them in the first place, but having made a barshly lighted negative, here is one way of making the best of the situation. Place a piece of ground-glass of the right size next to the emilsion side of the negative and project or contact-print through the negative. The ground glass,

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coming between negative and paper, will break up the direct rays of the light and cause a light dispersion that will bring about the desired diffusion, avoiding abruptness between the shadows and strong highlights.

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REATED simply by bending a chromium tin and photographing the tin reflection at an angle, "Something New in Headgear," may provide an impulse for



"Something New in Headgear"

working out comical notions. The distortion effect achieved depends on the subject used, the degree to which the tin is bent and tilted. and the camera angle. The tin is held rigid in any given shape by the use of string on each side

This is one of a large number of tricks, comprising a sort of "trick encyclopaedia included in a little book on trick photogra phy by "yours truly," soon to be published

CLEANING TRAYS OVERNIGHT

F you have your own darkroom, sink and all, here is a tray cleaning tip that has been handed on to us by an old timer. After a day's work he pours the stop bath into the emptied developer tray and leaves it that way overnight. When he comes in the next morning, he tears a sheet from his newspaper before walking into the darkroom and, after emptying the stop bath from the developer tray, crumples the newspaper and uses it to wipe out the thin layer of sediment on the bottom and sides of the tray. The tray is then thoroughly washed before use.

WASHING ROLL FILM IN TRAY

N these days of film developing tanks, which serve for developing, rinsing, and fixing, plus washing, the "see saw" method of developing film rolls in a tray is rather passé. However, there are doubtless many persons who still do not own tanks; also there may be some who would not have one as a gift but prefer the old ways to the new On the other hand, it may sometimes be found convenient to develop see-saw fashion in a tray. At any rate, if and when you do. here's a washing tip. Form the film into a horizontal circle with the emulsion (now negative) side out Overlap the ends and fasten them with a pin or clips. So joined, the film will stand on edge and will be washed clean of hypo in 20 or 30 minutes.

WHAT'S NEW

In Photographic Equipment

(1) you are interested in any of the items described below and cannot 'nd hem in our advertising columns or at your photo graphic dealer, we shall be glad to sell you where you can get them. Pleuse accompany your request by a stamped envelope

KODAK FLASH SYNCHRONIZER (\$7.50) For use with current model Kodak cameras having shutters accepting cable release Battery case of black molded material holds two 112 volt cells Lamp socket, of quick action type with four springs, holds No 7, 11A, 16, or 16A Photoflash lamps in cor rect position in front of highly polished spherical reflector. Housing on side of batters case contains operating plunger, ad justable switch contact, and container for head of cable release. Cable releases to fit cameras with which Kodak Flash Syn chronizer are to be used must be purchased separately. Longer cable release necessars for some cameras than ordinarily used Recommended procedure set for hulb ex posures. May be adjusted to 1/50 of a secand shutter synchronization. A 212-volt lamp, miniature socket, cord and plug to fit lamp socket in battery case, plus instructions, supplied for this purpose Camera is attached to metal camera support bracket by large knurl-headed screw fitted in cam era's tripod socket Battery case of syn chronizer attached beside camera on same bracket

Federal Enlarger Model 440 (\$27.50) Takes negatives from 35mm to 214 by 314 inches and intermediate sizes. Supplied with 1/63 anastigmat lens. Features condenser lens and illuminating system in cludes 41/2-inch condenser lens and ground diffusion plate and special parabolic reflector, convertible glass or dustless metal plate negative carrier, new adjustable metal mask, quick-acting clutch, double spiral focusing, lens mounted with click disphragm and built-in red filter, cool lamp housing, 36-inch steel upright post mounted on heavy 16 by 22-inch hardwood base board Accessories included projector lamp, underwriters' approved control switch, cord, and plug Works on AC or DC

RAYGRAM BOX TYPE BEADED SCREENS (\$10 to \$20). Made of Dupont screen cloth, with coated back and beaded with graded blue white glass heads. Important feature semi-automatic frame When screen is pulled out of case, it automatically stands erect Slight pull on release cord all that is necessary to close it. Made in four sizes.

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PARA FILTERS Combination sunshade and filter set. Base arranged on revolving filter set. Base arranged on revolving lens flange, slotted to permit insertion or removal of filter, a half turn of sunshade opens or closes slot. Designed to slip over regular camera lens. Two types of mounting available one having set screw, other with six spring tension points which grip lens barrel Set complete with five color fused optically flat glass filters, light yellow, medium yellow, orange, green, and red. Heavily constructed, chrome-plated Instructions supplied covering filter factors for five filters in either day or artificial light, with information on type of film.

FEDERAL ENLARGER MODEL 246 (\$49.50)

Takes negatives from 35mm to 21/4 by 314 inches and intermediate sizes. Complete with f/4.5 anastigmat lens. Specifications, double extension bellows (takes lenses from 2-inch focal length to 5 inches), double condenser lens system, enlarger convertible to condenser or diffusion illumination or combination of both, opal lamp on adjustable slide, with special parabolic reflector, supplies even light distribution, convertible glass or dustless metal plate negative carrier, new adjustable four slide metal mask: dustless metal negative pressure plates: pegative pressure release permits negatives to be removed while in machine without scratching, micrometer focusing control; four-element 3½-inch f/4.5 anastigmat mounted in removable lens board . counter-balance adjustment: double ventilation radiation fans in lamp housing, rigid steel 36-inch upright post mounted on heavy 16 by 22-inch baseboard; enlargements from 11/2 to more than 8 times on baseboard with 31/2-inch lens, greater by projecting on floor, enlargements up to 18 times on baseboard with 2-inch lens Accessories included large red filter, 75-watt opal enlarging lamp, focusing target, approved cord and switch. Works on AC or

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JACOB DESCHIN, conductor of our "Camera Angles" department, suil answer in these columns questions of general interest to amount photographers. If an answer is desired by mult, enclose as sumetic, discussed envelope, Questes should be specific, but Mr. Dochnic camera undertake to draw compensions between manufactured products nor to advise on the nurchase of enumental or materials.—The Edino.

Q. Can you advise me about taking snapshots indoors in daytime with light from windows and doors? I usually use orthochromatic film.— C. M. M.

A One of the fast panchromatic film emulsions would be more stated to this putpose, especially where it is necessary to keen exposures at a minimum, as in the case of nortraits. An extinction type exposure meter will frequently be more useful in taking indoor readings than the photoelectric type Of course, the reading should be made from the shadow side in order to make certain that shadow details, where wanted will be recorded. In making spanshots of persons indoors by daylight have the subject seated a couple of feet or so away from the window rather than close to it, and at an angle of 45 degrees to the light coming from the window For the shadow side, provide a reflector of some sort to catch the window light and throw some of it into the shadows A newspaper or pillow case, for example, will do In taking interiors, the lightness or darkness of the walls and furnishings will make a considerable difference in the required ex-DOSUFE

- Q. Will you please tell me how I may treat my table so that hypo and developer will not harm the paint?—H. S. McC.
- A. An efficient protective covering would be a strip of linoleum or sheet rubber. Oilcloth has been used, but this is usually too thin, cracks easily and is generally not very reliable if you are particularly anxious to protect the paint on your table.
- Q. I would like to make some money with my camera hobby, Would you recommend some books? What is the best way for someone living out here in the Far East (Java) to make contacts with the right people. I have trips, trips to the seacoast, the natives, and so on. Some of them have been accepted by local illustrated papers.—W. A. C.
- papers.—W.A.C.

 A. Among several of the more popular
 books on the subject are "Camera Journalism With the Miniature Camera," by
 George W. Hesse: "Free-Lance Journalism
 With a Camera," by Rufus H. Mallinson
 (an English publication); "Making Ama-

teur Photography Pay," by A. J. Euckson, and "Where and How to Sell Photographs," by H. Rossitter Snyder. A valuable guide to markets is the Universal Photo Almance and Market Guide Probably the best way to make market contact for personal properties of the personal properties of the personal prices of the personal prices and personal persona

- Q. Is 35mm Kodachrome obtainable unnotched? What is the finest fine-grained black and white 35mm film obtainable?—F. C.
- A. To our knowledge, all 35mm Kodachrome film is notched both for the purpose of fitting the sprockets of ministure
 cameras and to facilitate processing in Rochester. Several film manifectures make
 what they claim is tops in fine grain; we
 would suggest, therefore, that you make
 tests with the various films and settle the
 matter for yourself
- Q. Would you kindly inform me of some authoritative source of information on the reversal process for cine film? Also, I would like to know where I can get hold of 16mm film without paying the processing price at the same time.—N. G. A.
- A. "Motion Picture Laborstoy Practice," jublished by the Eastman Kodak Company and "Home Processing," by P. W. Harria, are reliable tests on this subject. Of course, you know that positive film can be purchased but this will have hunted possibilities. At the present time 16mm motionpiture film cannot be purchased without paying the processing charge, but it is expected that the Gewart Company of America will shortly have available move film for home processing.
- Q. I would like to know the formula for a film cleaning solution containing ethyl alcohol.—R. S. J.
- A. Here it is, thanks to the "Leica Manual": Ethyl alcohol (pure grain alcohol) 85%

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

TELESCOPE makers who plan lighturged to study the proportions of the tripod in Figure 1. With the heavy mounting and 4' refractor the total weight is 288 pounds John McLennan, 1424 Onkwood Ave, Akron, Ohio, is the maker and he says the four main castings are of bronze with proportion 85 percent copper, 15 percent un The rug-



Figure 1. McLennan and telescope

ged axes are 2" and 2\%" in diameter, respectively, and both turn in precision ball bearings filled with grease

There are setting circles on both axes and the polar axis has a slip ring for setting on sidereal time when starting to observe "When making the working drawings for

"When making the working drawings for the mounting I did not think it would work out so heavy." McLennan writes, "but I am very well pleased with it I am not a machin-

ist—just a home-trained mechanic"

Not only is this mounting rugged but it also is clean, regarded as a piece of design Excellent proportion

REFRACTOR making is beginning to carbo on A dende ago it was being discouraged for amieties. When "ATM" was first put together, largely from Blison's book. The Amieties's Telescope," the full American reprint rights of whis were pur chased, Ellison's chapters on the refractor, is the amieties' and the By 1928 (second edution of "ATM") we had softened enough to insert a guarded note on "The Objective Lens" (spage 25g, 2nd ed.), polnting out the difficulty of the work, and that same note, only lukewarm on refractors, was reprinted in the third and fourth dutions (page 333). Last year, when we

reprinted the fourth edition, we slipped out that old discouraging note and substituted one that now encourages the amateur to make a refractor. Thus, 13 years produced a complete about face. Just a diplomatic way of saying that in 13 years the amateur has steadily incen. risen, risen in has ability.

way of saying that in 13 years the amateur has steadily risen, risen risen in his ability. Speaking of refractors, the next item may throw some added light on them—literally.

IN Figure 2 are two pairs of supersoad, flatiated disks of fining jlass. You can see far more clearly through the pair on the right. This is because the latter have been coated with the new metallic fluorides, and the day may come when amstern depictive lens makers will send their components away to be treated, or do it threadly as any to be treated, or do it threadly as the components of the light transmission through a two-element objective Reiffactors give along the common to the light transmission through a two-element objective Reiffactors give along the testing the components of the light transmission through a two-element objective Reiffactors give along the testing the superson of the components of the light transmission that the light transmission that the light transmission to the light transmission through a two common transmission to the light transmission through the light tra

In 1892, H Dennis Taylor, a noted British lens designer, began to take notice of the effect of tarnished films on lenses when some flint elements were returned for repolishing His tests showed that, if a photographic plate was exposed under identical conditions, through a tarnished and an untarnished lens, more light would reach the plate through the former Said he "Whereas a thin plate of dense flint glass of the type usually used for objectives will, when freshly polished, reflect back from its two surfaces about 11 percent of the light falling upon it, and transmit 89 percent, the same plate when tarnished . . will reflect back only about 5 percent, and transmit 95 lenses artificially by immersing them in various solutions, and found that hydrogen sulfide and alkaline sulfides reduced reflection appreciably.

In 1916, Kollmorgen, "acting upon the hints contained in Taylor's description, experimented a good deal with different chemicals along the same lines and found means of exidizing most of the glasses used in optical work," according to a paper delivered before the Illuminating Engineering Society

At about the same time, Dr. Hermann Kellner, who was head of the Scientific Bureau of Bausch and Lomb, was working along similar lines He mentioned his ex-

perments to Dr. F. E. Wright, during the latter's labors at the Bausch and Lomb plant in 1917, as a member of the group of sheate chemists aiding the Government in securing its requirements Dr. Wright began a series of experiments with Dr. J. B. Ferguson Although these were never conducted, reflectivity was definitely decreased and the control of the piece of of the p

etching by the attacking solution, the surface becomes covered with minute pits which are small compared with the wavelength of light.

In 1936. John Strong described a physical method of coating films to produce the same effect as the chemical method. His process involved the evaporation of metallic fluorides in a high vacuum. He described the use of a film of decreasing index of refraction which starts out with the full index next to the glass. This was done by depositing a film of fluorite, solid below and porous above. Agreeing with the Wright porosity is small compared with a wavelength of light, as evidenced by the fact that it does not scatter light " With such a film he noted decreases in reflection of from 54 percent to 85 percent, depending on the angle of incident light.

angle of incident light.

Since Strong's work several physicists have used this technique, among them being Cartwright and Turner who have used various metallic fluorides to produce imperceptible films on glass to increase the transmission of light.

Simultaneously, Dr. Katherine Blodgett, working on a project originally instituted by Dr. Irving Langmuir, employed films of barium stearate and other fatty acids to form a thin molecular surface on glass The glass was dipped into a tank of liquid on the surface of which an insoluble soap one molecule thick was placed. As the glass was dipped down, one layer of film was attached, and on withdrawal another layer was applied, each full immersion adding two layers, each one molecule thick It took 44 successive layers to build up a film to a thickness of a quarter wavelength of light Dr Blodgett came to the conclusion that, except for the loss of light by absorption in the glass itself, film treated lenses could be made to transmit 100 percent of the incident light.

The metallic fluorides, however, are much tougher films than the fatty and types in the long series of investigations conducted by Dr. W. B. Rayton in the Bauch and Lomb laboratories during this period, it was evident that a combination of two processes could be used to greatest advantage. On lennes having an exposed outer surface a corrower chemical process is used in removed from the surface. Jesuing an information of the process of the surface length and the process of the surface length and the surface. Jesuing an In-



Figure 2: Contrast-the old and the new

visible structure of silica, while the inner glass-air surfaces are coated by the deposi-tion of a metallic fluoride in a high vacuum.

In both processes the coating is held to a thickness of a quarter wavelength of light. or about four millionths of an inch The film must be intermediate in refractive index between air and glass. Since both the film and the lens surface reflect light, it is necessary that the crests of the waves from one beam shall fall into the troughs of the other Thus, being out of phase, the waves neutralize each other and reflection is decreased or entirely eliminated. The missing radiation reappears in the transmitted beam which has been shown to contain as much as 996 percent of the original radiation.

From 4 to 6 percent of the incident light is lost at each glass-air surface of a lens, the precise amount depending upon the type of glass used and the color of the light A crown glass-air surface reflects about 4 percent of the light, whereas flint reflects 6 percent It will readily be seen that, in a lens with a number of elements, or in optical instruments with complex sys tems of optical parts, light transmis can be increased tremendously Equally important is the reduction of halo and the improvement in image contrast

The new coating processes are at present being confined to a limited number of prod ucts but the progress so far attained offers a wide field for experiment which may prove a great step forward in ontice. One advanced amateur who has seen some experi mentally coated bipoculars says the difference is striking, as binoculars have from 10 to 15 surfaces, giving fine opportunity for the beneficial effects to pile up.

HIGH cost of gas for melting quartz original intention of making the 200" ror disk of that material, as the melting point of quartz is very high Behind the following communication from John Ferguson, consulting engineer, 4 E. 194th St. Cleveland, Ohio, may be something new and significant

id signincant "I send you," he writes, "a photograph (Figure 3) of a paraboloidal mirror which is unique. It is made of borosilicate glass, 18 15" in diameter, 3" deep, and of cellular construction I believe it to be the first mirror ever to be made from glass which



Figure 3: Ferguson and unique disk

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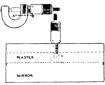


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THE BEGINNER'S COUNTR

ALMOST the first concern of the begin-ner is to tell how deep the curve of his mirror has been ground. The classic way to do this is by means of a curved template but there are shorter, better methods The illustrations show the simple yet efficient one devised by Paul G Blaisdell, M.D., 102 N Madison, Pasadena, Calif. and are almost self-explanatory. The anvil



part of a five and-ten cent store micrometer calipers reading to a thousandth of an inch was sawed off along line A-B. in the Doctor's drawing, and discarded, leav ing a stub for anthorage. A paper collar was fastened around the mirror disk, just



as in preparing to make a pitch lap, as described in the book "Amateur Telescope Making," except much higher. The spindle of the micrometer was run back till its end was flush with the remaining part of the frame, the micrometer was centered and held accurately on the glass, and plaster of Paris was poured around it. Before any grinding was done the actual reading of the spherometer was noted and used thereafter as its zero point. The photograph shows how it is used, the other hand holds the plaster disk in accurate register with the class

Dr Blaisdell states that this spherometer gave readings that checked with solar forms readings and cost only 35 cents to make. He obtained his micrometer from The Pep Boys, 169 W (olorado St., Pasadena, for a little less than a quarter

TELESCOPTICS

(Continued from preceding page)

was melted electrically, as distinguished from fuel fired furnace melting. The process of melting the glass was developed by the writer, the heat for melting being generated by the flow of electric current through the glass material itself, acting as a resistor

"Glass at normal temperature is a good insulator, but it is capable of conducting current when heated. In this respect it is classed as an unstable resistor, its resistance becomes progressively lower as it is heated Being a liquid, it cannot burn out, as solid resistors will do at high temperatures, so the melting temperatures can be pressed up to as high values as the refractory containers will withstand, and one of the advantages of this is that very refractory glasses can be melted

"It may, of course, occur to the reader to wonder how the glass ingredients sand. borax, soda, lime and so on-are brought to an initial temperature condition where they will begin to conduct the current in appreciable quantity. They become conduc tive at 500° to 600° C, and there are several methods of producing this temperature, after which the flow of molten glass and the entire process becomes continuous.

"The electrical process of melting glass appears to promise glasses of superior characteristics for mirrors. Glasses have been successfully melted with a silica content as high as 87 percent, with quite low expansion factors The nature of the operation also will lend itself to the production of quite large mirrors at considerably less cost than has heretofore been possible

It is said that the process is already in use by two large American glass companies making glass for purposes other than mirror disks. A detailed account is to appear in the Journal of the American Ceramic Society What effect this process may have on the availability of mirror disks having a higher silica content, and therefore less expansion effect, than those now available, this department knows not at the present writing Pyrex disks of the sizes most commonly sold to amateur telescope makers (under 1214") contain 80 percent silica, the larger ones 87 percent

O all quarters of the earth goes Sci-TO all quarters of the earth goes Sci-entific American and many of its readers obtain "ATM" afterward. One is the Rev Lmil W Menzel, of the American Evangelical Mission, Bisrampur, C.P., Via Bhatapara (BNRy), India, whose telescope is shown in Figure 4. It has a 10" mirror made of a port-hole glass and the mounting is of the open, "spinal column type, the neat column being a piece of steel channel It is equipped with setting circles "Since I live in the jungle it has been hard to get machined parts," its maker states, "and so the mounting is about as primitive as it can be and still do service. The long focus gives plenty of exercise climbing on boxes and tables. The telescope is mighty good company on lonely, hot nights when you sleep outdoors under the stars with it at your bed-side." Note the low angle of the polar axis, designed for the latitude of India's Central Provinces, in about 20° North.

LL mirror makers have been asked At whether the rouge they use is "the same kind" One answer might be obtainable simply by inviting the ladies in your circle to apply some of your rouge to their faces; no doubt they just wouldn't. Or by trying some of theirs on your mirror. Even so, how many users of red optical rouge, which is ferric oxide (Fe,O,), can say with assurance what, if anything, the two genders of rouge have in common, besides the color red, rouge being simply the French word for red (which, incidentally, makes one ask why some people call Levigated Alumina "white rouge").

These weighty questions having kept your scribe awake nights for the past dozen years, he asked Horace H Selby, author of the chapter on making optical rouge, as well as other chapters, in "ATMA," and who is a professional chemist, for the answers. Here is what Selby replied "You got me curious with your inquiry so I got some samples-three kinds-and went to work Was I surprised! Not a mil-



Figure 4 Menzel and reflector

hgram of red Fe₂O₂ in the lot 1 In two of the seven shades, I found approximately 3 per cent of a vellow iron oxide presumably other In general, all were drud cakes of gums (acacia, tragacanth or India) hold ing together mixtures of magnesium silicate ("French chalk," "tale" and so on), alumi num silicate (colloidal kaohn or clay), calcium carbonati (chalk), zinc oxide and colors Of the colors, I identified the fol lowing ammonium carminate, carminic acid, a fluorescein salt, yellow other, a nitro fluorescein-possibly cosin scarlet Some other colors were present which I couldn't spot easily They were lakes, and some were blue, some yellowish The preponderant colors were of the cochineal group, however (carminic acid and salts and crude car min)"

Accompanying this learned report, Selliv sent a table showing that seven rouge compacts were tested by him for 20 components each To keep the peace we suppress the makes, you wouldn't know them if you saw them, anyway (or would you?). Selby says he did about \$100 worth of work on the job. Knowing, however, that he would not be interested in mere money, we have decided to sward him, instead, and on behalf of all amateur telescopedom, an honorary degree. Now the degree of J. U D (Juris utriusque Doctor) stands for "Doctor of Both Laws," that is, canon and civil, so why not create for Selby the degree of R. U. D. (Rubrorum utriusque Doctor), which means "Doctor of Both Rouges". So be it, and Selby is ennobled for his rouge



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Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar

CROWN CAPS

A CROWN cap is not a valve. This is probably not news of a startling character to most of our readers. However, it has been judicially determined for the first time in a suit involving a patent on a tin

The patent related to a tin can having a docharge nozzle and manually operated valve controlling the nozzle. The patente brought suit for patent affirmerine against the manufacturer of a heer can having a pouring opening closed by a rown cap. It was contended by the patentee that the crown cap constituted a valve. The court however, after considering the dictionary definition of a valve, repeted this contention and held that a crown cap was not a valve nearest in suit.

BURBLE TOWER

A PROCESS patent cannot be based merely upon the apparatise employed in carrying out a process. This principle illustrated by a recent case for infringement of two patents relating to the dutilization of faity audie. Faity acids are derived from animal and vegetable faits and oils are faithfrom the faits and oils is to separate or split the oils and faits mite glycerine and faity acids and then to extract the glycerine by its a matture of faity acids and impurities. The impurities are removed from the acids by means of a distillation process.

In the distillation process care must be exercised because the fatty acids decompose before reaching distillation temperature at normal atmospheric pressure Therefore, it has been customary to distill the fatty acids under a partial vacuum or with a volitalization agent such as steam Prior to the inventions covered by the patents in suit, it was customary to distill the fatty acids in pot stills. The patent in suit disclosed the use of distillation columns or towers rather than pot stills. The first patent disclosed a distilling column or tower known as a baffle tower and the second patent disclosed a bubble tower. Apparently the patentees were the first ones to use baffle towers and bubble towers in connection with the distillation of fatty acids, although they had been used for many years in connection with the distillation of other products, such as petroleum.

The court found that the only difference between the prior distilling process and the patented processes resided in the inherent nature and operation of the baffle tower and the bubble tower. The court also found this the substitution of bubble towers and baffle towers, which were well known in analogous arts, did not constitute invention. As a result, the court concluded that the two patents were invalid. In this connection, the court observed:

"The difference between pot still distillation and continuous-still distillation as in reality a difference inherent in different types of apparatus. A process in the patent seense is a series of steps anvolving physical or chemical changes in the material operated upon. It converts that material operated upon. It converts that material prior call characteristics. Invention must be found in the sequence of steps performed on the material treated, not in the apparatus necessary to carry out the process."

THATCHED ROOF

LEEN our quaint and ancient modes of life are not free from the encroach ments of modern industrial evel-spinents and the second of the second

In applying the roofing material to the roof, the envelopes of successive courses were arranged in overlapping relationship and the protruding portion of the brush was of sufficient length to cover and conceal the envelope of the adjacent course The impregnated envelopes thus formed an effective water-proof covering for the roof and the brush merely served a decorative or ornamental purpose. In the old-fashioned thatched roof, it was necessary to provide a mass of thatch there of sufficient thickness to cause the water to dram along the ness to cause the vater to dram along to the roof boards along the control of the roof the roof

The court acknowledged the improved character of the patented thatched noof but nevertheless declared that the patent was invalid because of its close similarity to two earlier patents, one of which related to a roofing material consisting of a plurality of wires having their ends imbedded in water-proof envelopes.

O-KE-DOKE

IN an opposition proceeding involving the trade mark O-Ke-Doke, soft drinks were held to be goods of different descriptive properties from cheese and cheese-coated

A beverage manufacturer attempted to register the trade mark O-Ke-Dokee for soft drinks and the registration was opposed by a cheese manufacturer on the grounds that it was deceptively similar to his trade mark, O-Ke-Doke, for cheese and cheesecoated popcorn. It was contended by the beverage manufacturer that soft drinks were so different in character from cheese and popcorn that there was no danger of confu-

ason.

In an attempt to rebut this contention, the cheese manufacturer agued that cheese overed popons is sold and distributed in tavers along with soft drinks. In this connection, it was pointed out that the popons was advertised as a thrist creator and confidence of the content of the con

The court, however, concluded that the merchandise of the respective parties were of different descriptive properties and that there was no danger of confusion in the trade

In reaching the above conclusion the court made the following interesting comments with regard to taverns and drug and chain stores

"It does not appear from the record that taverus, which are alleged to be the principal outlet for opposer's goods, cater especially to the soft druk trade, and, with respect to the drug and chain stores whereight the goods of both partice appear to be solid, but it is a matter of common knowledge that when the solid is the solid partice appears when the solid partice appears when institutions sell an almost culmitted early variety of articles in distinct and substantially unrelated lines of trade?

MAMMY

A RESTAURANT proprietor was accorded the exclusive right to use the name Mammy in connection with the operation of a restaurant in a particular locality by a recent decision of the New York State Supreme Court

The decision ducloses that the plantiff in the case word the name Mammy's in the Case word the name Mammy's Chicker Farm on his restaurant and he prominently displayed the word Mammy in connection with a picture or caricature of a southern negres of the type generally known as a Mammy The defendant opened a restaurant in the same neighborhood and also prominently displayed the word Mammy and a smular picture Both establishments featured southern cooking of the type generally referred to as Mammy cock-

The court concluded that the use by the defendant of a name and picture similar to the plaintiff's constituted unfair competition, and awarded an injunction restraining the defendant from displaying or using the name or picture.

PARCHEESI

THE game known as "Parcheesi" has been popular me te United States for many years. Many will be surprised to learn that the name "Parcheesi" as registered trade mark owned by one manufacturer. Recently, a competing manufacturer manufactured and sold a similar game under the man "Parchees" and the original manufacturer filed suit for trade-mark infringement manufacturer filed suit for trade-mark infringement and unfart competition. Pending the trial of the suit the court granted a preliminary injunction restraining the use by the second manufacturer of the name "Parcheel" or any similar name.

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NINETY-SIXTH YEAR

ORSON D. MUNN, Editor

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INDUSTRIAL progress frequently revolves around a strict attention to small details. An example is the valve-stem testing machine illustrated on our front cover. This machine, used in testing the valves in Pontlac motors, presses a precision ground, cone-shaped diamond into the end of the stem. If the diamond digs deeper than the permitted tolerance, the stem is re-jected. Hand-operated machines work at a rate of 200 stems an hour; this new electrical tester checks 600 stems an hour.

SCHETTIFIC AMERICAN, May, 1864, 701 No. 183, No. 5, extend at the New York, N. Y. Pert Cities as second class maker June 18, 1879, under the set of March Act, 2879, additional mail, of Cores, Come. Perhibbed months by Moune & Company, May, May, No. 30 Novel 400, Novel, New York City, Copyrighted 1864
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50 Years Ago in . . .



(Condensed From Issues of May, 1890)

NEW DEAL? -"When the government buys what every one produces, and pensions every individual in the nation with the taxes collected from every one—the government will, of course, then dictate what shall be produced and who shall produce it."

LLEVATED—"In all city streats where there are two surface rail way tracks there is a space between them of little use except for direct crossing. To utilize this space is the object of the elevated railway illustrated. It carries two tracks, supported upon a single line of columns. Taken in combination with street tracks



below, it practically solves the question of rapid transit. The upper care move at high speed, make few stops, and carry people quickly to long distances. The lower cars move more slowly, stop offer, and take local travel chiefly. Long distance passengers can ride on the surface cars to the nearest elevated station and then take an express train."

BALI OONETS.—"Mr. Andre Mahoudeau describes, in Let Insentions Anuelles, a new kind of balloon desured by him, and divided into several compartments. One of the advantages of this system is that a reat in the halloon does not imperit the life of the aeronaut. Early compartment is provided with a pipe that descends through the artificial found in this way, it is possible to inflate the compart ments indopendently of one another, and with gases of different natures."

INVENTORS—"If there is any man to whom the term 'self-made' will must truly apply, it is the inventor. He must possess three general characteristics peculiar to all men who achieve success in life, but in more full development than most others, to wit, in genuity, enthusians, and per-verrance. Like the true poet, his soul is in his work, but his is the poetry of substantial achievement, which gives wealth, as well as happines, to mankind".

STEEL PIPUS.—"Steel pipes as a substitute for cast iron now form an important item for the engineer's consideration in the conveyance of water. Such pipes are being adopted for several reasons. As their weight is only about one-quarter the weight of cast iron pipes for the same service, the matter of transportation forms an important consideration. They are also much less liable to fracture than cost iron."

HEAV, GUN—"The first high-power, breech loading Banch rife made entirely of American steel lailey passed a successful test at the Naval Ordnance Proving Ground at Annapolis. The gun is one of four intended for the crusies Baltimore Lis forgings are from Bethlehem, and the machining and assembling were done at the Washington Navy Yard With a sample of Down prismatic powder furnished by Mesers. Du Pont, of Wilmington, Del, a muzile velocity of 4,129 feet presected as a distanted with a 110 part of the property of the property of the weighted 220 annual data as a second as a distanted by an British and while 110 this country."

LABOR SAVING—"One of the latest inventions is a machine for buttering bread it is used in connection with a patient bread cutter, and is intended for use in prisons, workshouses, and other reformatory institutions. There is a cylindrical shaped breads which is fed with butter, and lays a thin layer on the bread as it comes from the cutter. The machine can be worked by hand, steam, or electricity, and has a capacity of cutting and buttering 750 loaves of bread and nour. The saving of butter and of bread and the decrease in the quantity of crumbs is said to be very large."

AND IRON MEN—"The largest wooden vessel aftoat is the Rappahannock She was built at Bath, Maine, and cost \$125,000
The vessel is 287 feet long, 48% feet beam, and her total tonnage
is 3,053 net. In the construction of the ship 700 tons of Virginian
oak and 1,200,000 feet of Virginian pine timber were used The
ship has a steel howspirit, which is an innovation Her spread
of canvas will be 15,000 yeard.

SURGERY—"At the Surgical Congress as Berlin, Professor Cluck, of Berlin, gave—as rehibition showing a most valuable advance in surgery, namely, the successful substitution of estact, vory, and home freed from centred the cases of patients in whom there had been an insertion of from at to fine estatutes of cases of patients in whom there had been an insertion of from at to fine estimates of cases to estate the payle defects in the leaders of the hands, to which complete mobility had been restored. In the case of another patient Professor Cluck removed a tumor from the thigh, causing a considerable defect in the bone. He meetred over, and on shortening canade."

POWER. "A scheme has been organized and work begun to generate electricity, by the aid of Nagara, sufficient to drive all the machinery in the mills and factories, propel every horse car, lighting organized properties of the properties of the properties of the Nagara Falls, the city of Buffalo, and the neighboring towns and village. The present plans contemplate the production of 120,000 horsepower, but there is no limit to the amount of power which may be produced.

AND NOW FOR THE FUTURE

- ¶ What sort of inventions will help to win modern wars? By Major William H. Wenstrom.
- Long-range weather forecasting based on findings in a bog By W. F McCulloch.
- ¶ Commercial possibilities of tantalum, a new-old metal. By Philip H. Smith.
- ¶ Marvels of the aurora borealis, with illustrations by William Crowder.
- Artificial lightning, a big gun of science. By C. W. Sheppard.

Personalities in Science

CHINA in the early 1920's presented a picture of chaos. Warring factions ravaged the country Nivetths less, by extremely roundabout method, the conflict in Clinan contributed heavily to a chain of events that has led to actualing new knowledge of the world in which we live, a promise of future to the world to the 1939 North Clinal line of the world to the swarf out the 1939 North Clinal line physics to Dr. Ernest O. Lawrence, developer of the atoms mashing evolution and professor of physics at the University of California.

Following the close of the World Warthe Federal Wireless Corpany had planned to establish a large station in Clima. An 85-ton magnet had been constructed for use in this establishment. The turmoil in China forced reconsideration of these plans, consequently the company was left with a buge magnet which it was auxious to dispose of

The magnet was purchased by the University of California, to be used as the heart of a new machine called the cyclotron. This machine was to be used by Dr. Lawrence, then newly-arrived from Yale, to explore the interior of the atom. A much smaller evelotron had already been constructed and had proved its worth in the laboratory but this was mere child's play in comparison with the work which Dr Lawrence desired to perform. He wanted to break up the closely knit structure of the atom to see what it was really composed of, and to find out what results might be obtained when the tiny citadel in the nucleus of the atom had been destroyed To do this he needed a cyclotron many times larger and more powerful than his laboratory model. The first requisite was to purchase a large magnet cheap The one owned by the Federal Wireless Company answered these qualifications

The new cyclotron, with its 85-ton magnet, was installed in the Radiation Laboratory at the University Once it was put into operation excitung news began appearing in scientific journals. Lawrence had smashed the atom more easily than it had ever been done before. He had created strange new substances, never before seen on earth. They were simply sodium, phosphorous, or iron, when they were first put under the blast of the cyclotron, but after being sub-



ERNEST O. LAWRENCE

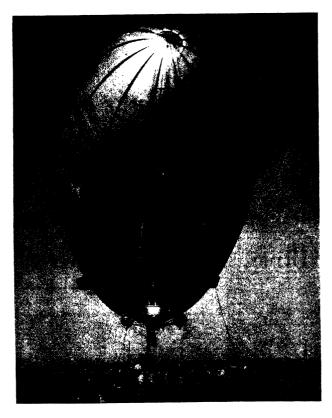
jeted to bembardment they be ame the world aradinastive. For the first time the world of came into possession of radioactive for the first time and the manufactured at a materials that could be manufactured at a think and the aradium, and had adountages over radium through the ease with which they or radius time, the neutron ray, was discovered And, while all of these discoveres were read of fundamental importance to the too have tremetidous significance in the field of medium of the discovered where the materials is the same of physics, they also have proved to have tremetidous significance in the field of medium.

During the just year the new W. H. Crocker Radiation Laboratory has been constructed on the University of California campie. It contains, heside a new giant cyclotron with a 225-ton magnet, facilities for laborator experimentation with the new radioactive materials and for treatment of cancer with the neutron ray. Now Dr. Lawrence is planning the construction of another and even larger cyclotron—one weighing 3000 tons—with which he hopes to un-

leash the energy locked within the atomic structure, if he can get the money

The University of California physicis is one of the youngest men ever to be awarded a Nobel Prize. With his youth he combines imagnation, resourcefulness, enthusiasm and, above all a keen, analytical mind. He has surrounded miself with a particularly able staff and missist that they share every honor with mill. Under the impetus of Dr. Lawrence's executive ability and far-sightedness, the Radiation Laboratry has become a research institute of the highest rank.

Dr Lawrence was born in Canton.
South Bakota, in 1901. He is a graduate of St Olaf College, Northfield, Minnesota, and the University of South Dakota.
He holds M.A degrees from the University of Minnesota and the University of Chicago, and a Ph.D. from Yale University. Before coming to the University of California, he was a member of the faculty at Yale For recreation he likes ice skating, botting, and tense skating, botting, and tense has time to the control of the



FLAGSHIP OF A RECORD-BREAKING FLEET

OVER the bumpy art of New York City, five blimps, of which the Rambou shown above is the flagship, have flown almost continually for many months. Filled with helium, paying little attention to the vagaries of weather, these ships have proved the air-worthness of this type which is discussed in the article on the opposite page. Up to April 1, 1940, these five Goodyear arrishps had flown 3,646-000 miles in a total of 134,771 flights and 81,631 hours of flying time, carrying a total of 362,231 passengers without accident. Such a record makes understandable the Nays's deare for seuch ships



noisi U. 8. Navy photograph.

Only a small ground crew is necessary to dock this sleek little craft at Lakehurst. It is filled with non-explosive helium.

BLIMPS AND MODERN WARFARE

I N an effort to round out our naval defenses. Congressman Vusson Charman of the House Naval Afairs Committee, early this year introduced a bill to provide for further expansion. Included in the proposed au international control of the proposed au thorizations, so me which permits the President to acquire lighter-than air crift so that a total of not more than 36 useful ships of this type may be main tained. This is the largest such program ever proposed for the United States in time of peace.

None can deny the advances made with the airplane, but this form of flying has not out-moded the airship for wartime uses. Both have limitations but the one can supplement the other What many have forgotten is that there are two major branches to the science of availation.

Lighter than-air comprises various types, just as we have the larger patrol planes and the truy fighters in heavier than-air. The Navy, charged with the development of the rigid ariship in this country, is still hopeful that further development of this type will be permitted but, meanwhile, believes in the efficacy of the non-rigid, or blimp, for training, patrol, observation, and other duties.

Neglected Type Used Successfully in World War ... Potentialities for Scouting, Patrol, Convoy Work... New Bill Calls for Several Dozen

By BROCKHOLST LIVINGSTON

Waen the first World War broke out. the nations knew little of the capabilities of blimps. It was not long, however, before most were utilizing these ships for all manner of purposes Even when filled with hydrogen, that demon of the airship, belligerents' blimps made many thousands of successful flights. As the only available lifting gas, hydrogen had to be used even though it increased the vulnerability of the ships. At present, we alone of the nations of the world ossess a supply of helium a non flammable lifting gas but we have given little attention recently to airships as an arm of national defense

WHEN we entered the war in 1917 we hurried as best we could to make up our deficiencies but our earlier neglect necessitated the importation of instructors from the Allied air services Eventually we constructed a large number of bitmps which saw service along our own coasts and from base constructed. In Europe In a future emergency, we might not be fortunate rought to have allies to hold off the enemy for us while we build up our defense. That is probably why arrised to have been included in the expansion

In the last 18 months of the first World War, the Britsh mantaned an average of 56 blimps, in service and in that period undertook 9059 patrols and all extractions of 2210 executs. Blimps located 134 mines and destroyed 73 of them They sighted 49 submarines and attacked 27 with the submarine work by blimps was accomplished either ginfire or bombs. Anti-submarine work by blimps was accomplished at far less cost than were similar tasks, performed by surface vessels although, for best results, the two types should,

and did, co-operate fully with each other. Most authorites claim that no ship under convoy by blimps was sunk by authorite to show a sunk to the convoy in the latter figure as correct, who, Even accepting the latter figure as correct, the efficacy of the blimp, conadering on the many thousands of ships escorted, is almost phenomenal. It is worthy of note that while the British began the present war without blimps, they have

instituted balloon patrols for spotting mine-laying operations.

In 1915, blimps flew only 339 hours, but in 1918 their operations and the number in service had so increased that 53,554 hours were flown. For every blimp fatality, 42,548 miles were covered In the final eleven months of the last war, there were only nine days in which airships were grounded because of bad weather This latter fact is of particular interest in view of the criticism direct ed at airships because of their supposed vulnerabil ity to weather

Interesting statistics were prepared by the Navy De partment shortly after the Armistice in 1918 These showed that a large nonrigid in France had an average percentage time spent in operations of 27 and flew 5270 miles in the last month of the war as against averages of 45.7 for destroyers which covered 4582 miles, and 474 for coastal patrol vessels which sailed 2540.9 miles. The airship's flying time was

airship's flying time was 2005 hours producing an average speed of 26.5 miles per hour which compares favorably as a convoy speed The airship's operation record includes only time attaully under way, while that for the other ships covertime spent at anchor during darkness as well. The comparison is very favorable to airship's. To refute claims of the airship's dependence on favorable weather, it may be added that in the above case, it was "worse than average" for the month.

Despite the favorable results obtained from blimp operations in the last war, the end of hostilities saw the beginning of a long period of neglect for this type Interest in the development of rigid air, aships and the phenomenal advances with the airplane retarded progress with a type which had proved its worth in war. Only a small fraction of what has been spent on experiments

tion with airplanes has been devoted to ariships. Even with the limited funds available, however, great strides have been made by the airship branch of our navel avaiton. No longer is the airship tranch of our navel avaiton. No longer is the airship actude, till-shapen thing. If "streamlining" and other modern developments much those of the airplane Handling and operational advances have been made to the time of available means.



Official U S Navy photograph
Two small blimps, T(-14 and G-1, seen through the partly
dismantled, German-built Los Angeles in a Lakehurst hangar

As lessons have been learned, the possibilities for extending the functions of the airship have increased. Besides the war-time duties of convoy and antisubmarine patrol which the blimp performed so well, the small airship has extended its usefulness to such duties as acting as aerial listening post offshore, carriage of infra-red optical range locating apparatus, photographing of the fall of shot in target practice, chasing practice torpedoes, and a long list of other important tasks Blimps have carried planes in hook-on experiments although this is more within the province of the large rigid ships Sea rescue work has been facilitated by the development of new devices recently tried out with success by ships from the Naval Air Station at Lakehurst (particularly anchoring devices to hold a blimp stationary within rope-ladder distance from the water - see page 161, March, 1940 Scientific American)
Many of these tasks cannot be undertaken by heavier-than-air craft due to
their higher speed, their inability to
hover, and their relatively lower useful
load capacity.

In a test conducted last spring by the Navy's K-2 it was demonstrated conclusively that blimps may be used on expeditionary work. The objects of

the flight were to test the feasibility of mooring a large non-rigid to an expeditionary mooring mast and of transporting mast and equipment by plane. to study the operating characteristics and generally to extend the range of usefulness of this type for coastal patrol operations Each of these was successfully fulfilled It was determined that the portable mast is adequate for mooring in reasonably severe weather and, on the flight in question, winds averaging 22 knots with peak gusts of 361/2 knots were encoun tered. It was found the mast could be readily transported by plane and quick ly erected at the chosen lo cation Only a moderate sized landing field and a ground crew of 50 men are needed for operations of this type

IT was recommended, following the completion of the flight, that the potentialities of the non-rigid airship be further investigated by means of similar operations and that the K-2 be used for the purpose.

familiarizing naval personnel with the possibilities of the blimp in support of local coastal defense measures. Nothing further along these lines was done, however, because the K-2 was damaged shortly afterward and no other suitable blimp was available. This is a sad commentary on our American reputation for progress.

Nothing useful can be proved by attempts to show the relative merits of the various types which make up a may atforce. Many proponents of the airship claim that one of this type is equal to so many cruisers or destroyers. Every known type has a distinct place in the scheme of defense and no one should be developed at the expense of another. However, we do know that, under given conditions, an airship can patrol a greater area than can any surface craft. Blimps are less expensive to construct and to operate than long-range patrol planes and cost but a fraction of surface vessels capable of comparable performance. The blimp, however, is not a combatant type and may be used to greater advantage for strategic than for tactical secuting.

Our present situation with regard to blimps is not reassuring. We have only eight Navy blimps available and some of these are not in operating condition. Only one, the K-2, was built specifically for the intended functions of a naval blimp The others, including two taken over from the Army when lighter-thanair activities were abandoned by them. range in age from two to ten years and are either adaptations of commercial types or fail to embody recent developments The K-2 and the two ex-Army ships are the only ones at all suitable for extended patrol duties. Endurance is dependent on volume, that is, rough ly 10 hours at cruising speed for each 100 000 cubic feet of volume. An airship must, therefore, have a volume which will permit it to maintain reasonably extended patrol A volume of 400,-000 to 500,000 cubic feet is considered entrefactory

Included in our available ships is the ZMC-2, a completely metal clad, as opposed to fabric-covered ship. This craft built ten years ago as an experiment, is considered to have proved the practicability of metal hulls but we have failed to follow up its possibilities by constructing a ship of larger dimen-

OUR ground facilities are equally limited. The air station at Lakehurst is the only one entirely suitable for lighter-than-air activities. The station at Sunnyvale, California, is now under Army jurisdiction but may be returned to the Navy when required At Cape May, Coco Solo, and San Diego. there are small sheds capable of housing from one to four blimps each. None is now in an operative status and ships suitable for assignment to them are not available Privately owned blimp sheds in nine different locations could be taken over by the Navy but several are so situated that they would be of little value as patrol bases. The U.S.S. Wright which started her career as a balloon tender is now employed with seaplanes, while the Patoka, recently recommissioned as an aircraft tender can handle rigids but has no mast suitable for blimps.

Our personnel situation is not more reasuring, in 16 years we trained only 175 officers as naval airship pilots and form many of these are no longer available to the Navy. There are few Naval Reservise, and the service, and enlisted personnel trained for lighter-than-air has been widely scattered due to the lack of ships upon which they could continue their interest in this



Official U. 8 Navy photograph
During wartime, blimps can acout the vicinity of merchant ships or convovs.
In this view the ariship 1-4 is making contact with a merchant vessel.

type All in all, the picture is not a bright one and yet situations are devel oning abroad which blimps belied to meet in the last war and could in this were they available. Whether we shall enter the war or not does not detract from the necessity of our being prepared in every respect and with every arm modern warfare can utilize in its nursuit. The loss of the Courageous might have been avoided if blimp patrols had flown over her operational area to determine the presence or absence of enemy submarines. The Royal Oak might still be an active vessel of the British Navy if blimps had been on constant patrol duty outside the entrance to Scana Flow Because of its higher speed, the airplane cannot perform these functions as well as the airship. Flying over the sea at 150 miles an hour, one is more likely to miss objects below than if he is flying at only 50 miles an hour

No one claims that the blimp is the answer to all our air problems but we had fairly conclusive evidence of it-efficiency in 194-18 If small, inexperience of its problems of the size of

There are disadvantages to the airship and these are fully recognized by their advocates But, the same is true of every known type of naval vessel. We do not pit a cruiser against a battleship if we can help it and, similarly, we should not match the airship against stronger craft. The mission of the air ship is to carry out its duty with least rask, and evasion is one of its strongest defenses.

Blimps have a place in our naval esablishment The provision of the number of airships referred to in Mr Vinson's bill would permit the granting of educational orders in line with our industrial preparedness program This will make it possible to maintain at least the nucleus of an airship industry in this country. The ships to be provided will also permit the first large-scale operations both with the fleet and on local defense duties. It should be possible by these means to determine more accurately the full extent of the canabilities of blimps as adjuncts of the national defense and to continue the training of nersonnel which we shall need in an emergency Further development of experimental types such as the metal clad airship may also be undertaken Our extensive coast line makes the airship particularly valuable to us and our possession of the world's helium supply decreases the vulnerability of the type.

War rages abroad No man can foresee when or how we may be drawn into its flames. We have neglected the blump for far too long. It is time we got started on making up for our neglect. The program which has been proposed is evidence of a growing recognition of this.

Who Was Shakespeare?

RARELY has a magazine article aroused such widespread interest as the one by Charles Wisner Bar rell entitled "Identifying 'Shakespeare'" which appeared in our January number

Hailed by many readers as one of the most remarkable true detective stories of the time, the article was based on an investigation that its writer and his technical associates carried out with X-rays and infra-red photography on a series of ancient paintings long known to Shakespearean authorities as traditional portraits of the Bard of Avon

Through exigencies of space, Mr Barrell was obliged to confine his discussion to one of these paintings, the famous Ashbourne canvas, owned by the Folger Shakespeare Library, of Washington, D. C.

With the scientific media employed, he demonstrated graphically that the man who originally sat for this portrait must have been the mysterious Elizabethan Court poet and dramatist, Edward de Vere 17th Earl of Oxford

In his own day, Lord Oxford was known as the writer foremost "in the

rare devices of poetrie" but, at the same time, one whose "doings" could not "be found out and made public with the rest"

Of late years, his name has frequently been assort ated with the long disputed authorship of the Shakes-pearean plavs and poems, beginning with the publication in 1920 of 1 Thomas Looney's scholarly volume, "'Shakespean' Identified in Edward de Vere 17th Earl of Oxford'"

Mt Looney's work won the endor-ement of such scholars, historians and students of the Elizabethan period, as Dr. Gilbert Slater of Oxford University, Dr. Gerald H. Rendall, former Headmaster of the

Chatterbuse School, Alan Gordon Smith author of "William Cord, the Power Behnd Elizabeth," Src Geoffrey Callender, bistorian of the Todar Nasy and knighted for his writings on the Elizabethan Ag., Dr. Symmoul Freud, the psecho analyst, whose studies of the Shakespearean plays had a profound in fluence upon his professional theories, and John Galsworthy, the novelat, who helped distribute the book by Looney, Since Lord Oxford's long-hidden Reader Response to X-ray Revelations of Identity of Shakespeare, Published in January Number . . . Presenting Further Evidence from Other X-rays



A close-up view of the ear from the X-ray photograph shown below



Under X-ray examination, even the painted-over ear of the Ashbourne Shakespeare agrees with other portraits

career as poet and dramatist was first brought to light in 1920, more than 30 additional volumes of research and commentary relating to his life have been nublished

These facts are mentioned to make clear the point that, while Scientific American is not a literary or historical magazine. Mr Barrell has substantial corroborative backing for the conclusions that he drew from his X-ray and infra-red dissections and discussions of

the ancient Shakespeare portraits

Moreover, while Mr Barrell submitted for our consideration some 75 X-ray, infra-red and panchromatic photographs, together with voluminous documentation covering his studies of the Hampton Court, the "Janssen" and the Ashbourne paintings of the Bard, it was a manifest impossibility to pub lish anything more than a digest of his material in one issue of the magazine It also seemed necessary to concentrate on a single set of the dissective photo graphs. Those relating to the Ashbourne portrait were chosen. But equally interesting and telling evidence could have been used from the Hampton Court or "Janssen" paintings, which also indicate that they are disguised originals of the poet-Earl whose "doings" in the literary world of his own day were so difficult "to find out

The Associated Piess and other news syndicates treated "Identifying 'Shakes peare' With X-Ray and Infra Red Photography" as a special wire feature. As a result, versions of the story were printed in some 2000 newspapers news reviews and magazines throughout the United States and Canada Many of these items were given front page space In addition, many columnists, such as Walter Winchell Benjamin de Cassei as, Joseph Henry Jackson of The San Francisco Chronicle, Ada Hanifin of The San Francisco Examiner, Harlow R Hoyt of The Cleveland Plain Dealer, and so on gave the Scientific

American article much space From Manie to California and from Winnipeg to San Antonio, milliona on fewspaper readers had their attention called to the first discoveries of their kind ever announced in the field of Shakespearean research. Nearly a hundred prominent journals devoted editorials to the ensuing controversy. During one week, The New York Times, The New York Total The New York Post and The New York San commented at length. On January

(Please turn to page 299)

OUR POINT OF VIEW

Proportion

I N his thought-provoking article on "Man's Earthly Future," cocluded elsewhere in the present number. Professor Mather points out that, even though man now seems to have learned to control the environmental factors that invariably have externanted other higher mammal species within 3,000,000 years, and thus may survive indefinitely, he may lose this ability and thus may end in the same oblivious as

Judging by comments heard here and there in conversation, many prefer to believe only the best. They do not like to think of this old Earth which they call "ours" rolling on and on through apace without the presence of man to adorn it and, as they put it, take care of it. This earth with none to work the soil and fisheries and mines, none even to run awy with Kentucky hordes of gold or bother to look at them, everywhere peace revolung thought

But if this old Earth had a consciousness and voice it might chuckle and say, "Oh, don't worry. I hardly knew he was here. I'll get along fine. I always did."

There is, however, sound scientific basis for the cheerful statement that if man became extinct men would evolve against statement that if man became extinct. The most more of our cousins the appe. If not, then from our more distant cousins the monkeys And if all the primates became extinct, more would evolve If all the higher animals became extinct, more would evolve If all the higher animals became extinct, and the same animals would evolve, provided the environment were the same. All this might take a billion years or so but what a billion years or so but what a billion years or so but what a billion years or the course of cosmic time?

So man, modern man, civilized man, may be taking himself just a bit too seriously. What he most needs here is a sense of proportion—A G I

No Block to Progress

RECENT controversy between the Federal Communications Commission and Radio Corporation of American brings once more to attention an important phase in the development of television. Shall television transmission be commercialized — thus, as some hold, freezing television standards to the detriment of technical development—or shall commercial television programs be withheld and the art continue on an experimental basis?

Analyses of this problem requires some reteration of what has gone before Detail in a received felevision image depends on the number of lines into which the original has been broken for transmission. The receiver of course, must operate on the same line standard in order to reassemble the image so that it can be seen A receiver designed for operation on a 441-line signal, for example, cannot receive the images from a transmitter that is operating on a following the international forms of the properties of the properties of the signal for example, cannot receive the images from a transmitter that is operating on a following the signal for example, cannot receive the images from a transmitter at the case of the signal of the signal for example, cannot receive the images from a transmitter at the signal of the signal o

Opposite as these two factors of standardization and finance may appear, they are inseparably linked. A line standard must be set before a satisfactory system of commercial television can be established. And the 441-ine standard that is being used by Radio Corporation of America is under fire as possibly not being the last word. Some commentators feel that an attempt to establish commercial television on this standard would result in the freezing mentioned before Let's look at it this way. In this writer's opinion, 441-line television is good. Sometimes it is excellent. There is plently for work for engineers to do, for some time to come, in improving the consistency of excellent reception, decreasing the times of poor reception. And this work can best be done not in a standard basis has been set up. There will be one less variable for them to consider, one more fixed point from which to ouerate.

If this fact can be compled with an opportunity for the television companies to reduce a ceturn on their investment, the picture will look brighter. With money coming in, they will be able to improve their service, produce better invigrams, make technical advances that would be impossible otherwise. Without such financial support, television may languish in the laboratory for years to come. It all boils down to this. Good television is available now. Left sinake use of it, study it under the support of the support of the support of the support of the wide-spread operating conditions, improve it as much as possible. Setting at 441 line standard will not result in freezing progress. Rather, it should result in tremendous acceleration.

An Unwanted Investigation

If we are to believe the politicians, the Federal Bureau of Indeventation is rapidly becoming an American Gestapo and the Bureau's Director, I Edgar Hoover, a ruthless dictator with insidious power. The politicians want to investigate the Bureau, having already made up their minds that private citizens can no longer look for justice at the hands of the Bureau.

Of course, it may all have been a dream, but we seem to remember the wave of jungle law that swept over the country a few years ago. Public enemies took their toll of human lives—including little bathies who were kidnapped and murdered after inanom was paid. Local peace officers were power-less, when into the fight stepped an organization that had long functioned efficiently but had never had spectacular chores to give it publicity before. That organization cleaned up the "public enemies" down to the last unimportant individual.

The Federal Bureau of Investigation, under the leadership of its greatest Director. J. Edgar Hoover, indeed performed a spectacular task in a way designed to impress criminals of its power against them. For the new sense of security which the Bureau gave to the country, is grateful Naturally, the Bureau gauned a high and glorious esteem in the hearts of all Americans. Consequently it has been given the chance to expand and become more efficient In most respects, it is now the finest, most scientific, and consistently successful body of its kind in the world. Its record is spotless, for mether J Edgar Hoover nor any member of the Bureau can be bought or intimidated—never could be and never will be.

There are no political appointees in the Bureau, yet an investigation of it would put the Bureau into politics simply because Congressmen will necessarily take sides in the ensuing argument. This may be the intent of the politicanis—in order to grab some of the Bureau's glory for their own party or to open up within the Bureau in expansion go party members. No matter what the reasons behind the proposed investigation, it would play into the hands of organized crime, for criminals would like nothing better than to see the Bureau's powers limited In any case, the whole idea is indiculous, and if the investigation does go through, it is our firm belief that, not the Bureau, but the politicalism will be adjudged guilty of Cestapo practices—by a public that is grateful for the work of its Federal Bureau of Investigation and J. Edgar Hoover—Q.D.M.

Treasure In East Anglia

A DISCOVERY, unique in the history of western Europe, has been made in castern England. The county of Suffolk is already renowned for its wealth of archeological remains, but the discovery of a royal ship burial beneath a tumulus or repulchral mound at Sutton Hoo, near Woodbridge, is an event overshadowing in romantic interest all other discoveries in that part of Eng

When the Roman power, which for over 400 years had governed Britain, began at last to wane, enemy raiders, coming across the North Sea, started to invade that country. The earliest of these were the Anglo Saxons, who were followed in later times by the Vikings. who burned and raped and pillaged to their hearts' content up and down the whole length of Britain's eastern seaboard. All these people were sea-rovers. and when their great men died they were buried in the ships which had carried them on their voyages in this world and would be used for a similar exciting existence in the next

Clearly, the idea of an all-pervading After the departure of the Romans from Britain, a period about which very little is known began, and without much doubt was characterized by increasing lawtessness, fighting, and disorganization. But it is known that, toward the close of the 6th Century, a D. Redwald, the third ruler of the East Anglain tribes, held sway in eastern England. He died A Buried Anglo-Saxon Ship...Riches in Refined Gold and Silver Work...A Surprise to Archaeologists and Historians... Unearthed in England

By J. REID MOIR, F.R.S.

about 617 AD, and there are weighty reasons for believing that the treasure ship found at Sutton Hoo represents the grave of this warrior King

REDWALD'S history is of considerable interest. Under the influence of King Ethelbert of Kent he adopted Christianity, but, on arriving back in Suffolk, is supposed, under the influence of his wife, to have reverted to paganism It is believed, however, that from then on he kept, as it were, a foot in each theological camp, and in his temple at Rendlesham, some few miles from Sutton Hoo he caused to be exected two altars, one to the Christian God, and the other to the pagan derties. If this is true, the nature of the burnal found at Sutton Hoo becomes of much interest It was, in fact, aggressively pagan in character, and may represent Redwald's pagan interment, while his Christian burial may be elsewhere at a site not vet discovered In any case, no traces of human bones were found at Sutton Hoo, and, while this is possibly to be accounted for by the non-preserving nature of the soil there, it is equally possible that no body was ever interred in the tumulus, which represents a token burial to the high gods of paganism

The site at Sutton Hoo is on the north bank of the River Deben and is situated about 100 feet about the water. There are a number of tumuli at this spot, and, on the request of Mrs. E. Pretty, the owner of the estate, who generously financed the work, Ispawich Museum had excavated, during 1938, certain of the smaller mounds. The archeological



A six-inch gold buckle, of horse's head design, from the Sutton Hoo burial chamber in the ship below

results of these diggings were interesting, though not spectacular, as definite signs of boat-briails had been found, accompaned by cremated bones and certain funerary objects. These at the time were thought to be of Viking age but it was clear that the mounds examined had in all probability been dug into before, and it was not possible to decide with certainty the age of the burials from the scant objects recov-

In 1939, work was begun on the largest of the burnal mounds at Sutton Hoo, and it was not long before Mr. Basil Brown, in charge of the excavation, came upon evidence pointing to the

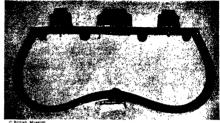


The western end of the ship discovered beneath a burial mound of earth at Sutton Hoo, England. The burial treasure chamber lay where the ribs are missing

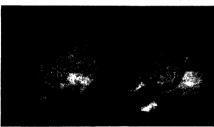
presence of a large ship underneath the tumulus. Though very little of the actual woodwork remained, the original shape of the vessel was clearly to be distinguished by the rows of large iron rivets still in place in the sand, and the evident signs of the position of the ribs of the ship.

She was 82 feet long, with a beam of 16 feet, and represented a more or less flat-bottomed rowing galley with 16 or 18 oars on either side. To the west less the Deben Estuary, ready to hear the ship away on her ghostly vovage to the far distant spirit land

It is possible to conjure up the scene when the burial of King Redwald took place. Evidently it was a somewhat lengthy process. First, the preparation



Gold frame of the King's purse, with sliding catch and hinged strap fastenings



Two of the nested silver drinking bowls found with their nine drinking horns



© British Museum
A silver dish, 15 inches in diameter,
bearing a female head in répoussé

of the trench for the ship, and later hauling it, by means of teams of horses and rollers, up the steep slopes of the valley side. These things no doubt took time and were followed, in all probability, by funerary feasts and ceremonies of an elaborate kind.

All these matters are intensely interesting, but when we turn to the contents of the wooden tomb chamber in the center of the ship, these feelings change to amazement. The richness and completeness of the funerary objects in a measure compel comparison with those found in Tutenkhamon's burial chamber in Egypt. Never before has such an array of beautiful gold and silver ob jects been discovered in a tomb in westein Furope, and no one had any idea that the East Anglian Kings of 1300 years ago possessed treasures of the kind uncarthed Clearly, the grave was that of a man, and the richness of the funerary objects indicated that he was of the highest rank. There were present his spears, axe, and sword, the golden pommel of which, and the massive boss from the center of the shield, were beautifully decorated with interlacing ornament and enriched with enamel

The excurator of Anglo-Saxon graves usually more than content if his labors are rewarded occasionally with a brooch crudely set with garnets, or one or two imperfect spearheads. At Sutton Hoo, however, was a massive gold buckle, possibly from a magnificently decorated word belt and nothing less than a masterpiece of Anglo-Saxon interlacing design. Also two pairs of splendid clasp-plates, possibly used as armlets, with rich decoration of sliced garnets and millefori glass inlaid and mounted in solid gold.

The great purse, of which the gold Europe.—Editor.

frame lay by the side of the presumed site of the body must, when entire, have been a magnificent object. The sliding catch of the gold frame is in perfect condition, and the workmanship and design of this and other objects is a revelation of the supremacy of Anglo-Saxon and Frankish art at this period

One of the most remarkable finds is a great whetstone, or honing instrument, four-sided, with bearded faces cut in relief at either end, which also carried bronze cup mountings But, in addition to these war-like furnishings, the grave contained many silver objects for use in the celestial feasts. A great Byzantine dish, made in Constantinople in the time of the Emperor Anastasius, lay to the east of the place where the body was presumed to have lain Beneath this dish, which bears inside its base the name and portrait of the Emperor, lav a silver dish 15 inches in diameter, bearing a répoussé female head in the cen-

In association with these were nine nested silver bowls, with the same number of drinking horns mounted in silver. Thus the dead King was to be enabled to entertain in the world of the shadows, and to pay his way with the 40 gold coms and two small ingots of gold which were found close by his magnificent purse.

purse
It is impossible to describe all the
funerary relics at Sutton Hoo the silver
spoons the numerous objects of iron,
some for culmary purpoves, and the
much decayed wooden specimens, one
of which may represent a musical instrument. All the relics are being treated and examined at the British Museum,
under whose suspices the final stages of
the excavation were carried out, and to
which, by the generosity of Mrs. Pretty,
all the finds have been present.

Archeologists are referring today to the Sutton Hoo discovery as the finest ever made in Great Britain, perhaps in Europe.—Editor.

DON'T WORRY—IT CAN'T HAPPEN

By JEAN HARRINGTON

JUST about a year ago, two German physicists who had been gunning at physicists who had been gunning at the metal uranium with neutron bublets, just to see what would happen, suddenly found that they had caused the buggest explosion in atomic history. It wasn't a big explosion in atomic history it wasn't a big explosion in an everyday sense, no Berlin window panes rattled at the blast, and no one heard the noise Blut it seemed big and loud to other physicists all over the world. They had never before known of an atomic blast of such tremendous energy and presently they began to worry about it.

Scientific American, for Ottober 1939, contained an article, "Two Atoms for One," which described the German discovery and the flurry of research and executement which followed. The new phenomenon was called "muchar isson," because Hahn and Strassmann, the two Germans, had found that their neutron bullets split the heavy cores of uranium (and a few other heavy elements) into halves.

Previous experiments had succeeded only in knocking chips off atomic nuclei and these operations released only a time fraction of the boundless energy locked up in atoms. But, when uranium eracked in two, 200,000,000 volts of energy burst forth in the form of radiation, heat, and speed

Scientists have long wanted to convert matter into usable energy, and this wathe biggest step they had ever taken in that direction. No matter that there was still an almost astronomical number of steps to be taken. Feverishly they began to attack uranium in their laboratories.

IT was soon apparent that quite a numher of strange and wonderful thunghappened when the uranium nucleus blew up as the accompanying diagrams shows. Beside the two main fragments, a few spare neutrons two or three per fission) were thrown off from the origmal nucleus. In addition, the two new atoms were unstable, crupping neutronand other particles in a whole series or chain of reactions until the, finally subsided. The result was a great hodge podge of new down and extra neutrons.

Farly last summer, in the modet of all this research, a chilly sensation began tingling up and down the spines of the experimenter. These extra neutrons that were being crupted — could thy not in turn become involuntary bullets flying from one exploding uranium nucleus into the heart of another causing

another basion which would itself cause still others. We must there a diagnetous possibility that the uranium would at last hickome explosive? That the samples being bombarded in the laboratories at Columba. University for example, might blow up the whole of New York Catv? To make matters more omnous news of fassion research from Germany, plentiful in the early part of 1939, mysteriously and abruptly stopped for some months. Had government censorship been placed on what might be a secret of military immortance?

The press and populace, getting wind of these possibly lethal goings on, raised a hue and cri. Nothing daunted, however, the physicists worked on to find out whether or not they would be blown up and the rest of us along with them.

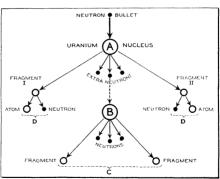
Now, a year after the original discovery, word comes from Paris that we don't have to worry—at least, probably not Frederic Johot, son-in-law of Mine Curie, and three co workers, you Halban, Kowarski, and Perrin, finally traced to its end the tumpilitudus course of the uranium fission chain reation. They

found that, instead of building up to a grand climax, it runs down and stops like an unwound clock

Their method was to measure the total number of neutrons emitted in one of these chain reactions. The original fission liberates two or three. They found that the remainder of the chain produced five or six more, an average of eight for each split nucleus. If the process were cumulative there should be far more than that

With typical French and scientificcaution, they added diata this was perhaps true only for the particular conditions of their own experiment, which was carried out on a large mass of ura num under water. But most scientists agreed that it was very likely true in general.

The key to the problem is probably the speed of the neutrons. In the origin and experiments it was soon found that made experiments of was soon found that the chair reaction proceeds, and more energy is released, the uran untarget becomes hearted. The extraordinate meaning the problem of th



Disgram of a theoretical chain reaction for uranium. The neution bullet at the top splits the uranium nucleux 4 into fragments 1 and 11 and, in addition, crupits three extra neutrons. One of the latter may hit another uranium nucleus B, and split it into similar fragments and neutrons (7. Each of the first two fragments may beach down into another atom plus a neutron, as at D. The total number of neutrons is each. Readers made insomnlous by "newspaper talk" of terrific atomic war vespons held in reserve by dictators may now get alego.

PACKAGED BY SCIENCE

THE package in which a product is sold becomes more and more important. Designers have tackled this problem with a vast amount of research in the effort to provide more attractive packages, packages that are more easily opened, and others hat provide combinations of advantages not bitherto available. On this page are shown a few of the 60 prize-winning packages chosen from more than 30,000 entered in the 1939 All-Americae Package Competition, sponsored by Modern Packageing magazine. Some of them are starting innovations. Offland, on might imagine all these developments simply the result of certain ingenuity displayed by the sales force, but their ingenuity goes deep into the processes of scientific research. None of them would be possible were it not that research departments have developed, for example, now hims resistant to pickle vinegar, never alloys resistant to fluids used in medical dressings, and new processes for handling and improving upon the uses of these and many other products.



Made of a heavier quality of the material Pilofilm, of which some women's rancoasts are made, a new pickle pack—pickles and juice—is a limp bag inside the window. More convenient for shipping, store shelf stacking, and general handling, the bag is opened by cutting with a knife

First wet, pre-medicated dressing, Tu-Ba Gauze, in a sterile tube Compact, for the first-aid kit, it holds a square yard of gauze wet with three ounces of medica tion. A thumb nail cut opens it easily



Eve-catching beauty of ruffling in these transparent counter display containers is over-shadowed by the protection against soiling and rumpling they provide. The transparent material is Vuepack Clerks touch only vardage sold, inventory means counting remaining rows in container-maining rows in container-



Lower Right. Shoe polish in a collapsible tube which screen into base of a brush. Squeezing the Shubador tube pushes shoe cream into the center of the brush. The cream stays fresh as it is not exposed, and the fingers do not touch the cream

A special award was given for the process made possible by this valve-headed can Corn is cooked in can in 30 seconds at high temperatures under vacuum. It is claimed to give a degree of flavor preservation never before attained in came



Protestion against contamination and loss of flavor is given to cheese by the transparent, inner bag While still hot and molten, the cheese is poured into a bag of Phofilm which is then head-sealed. Other foods—coffee and the pickles shown above—are also hermetically sealed in this same material which is rubbers, alightly elastic.





RAILROADBED HIGHWAY

In the forest fastness of Pennsylvania' mointains one of this country's last remaining frontiers is falling a victim of engineering achievement, as a small army of 1000 working cuts through a "dream highway" that is expected to the first him in a network of super high-speed motor roads from coast to

This four lane divided highway being bath at a cost of \$60,000,000, is called the Pennsylvania Turnjoke. Completed, the Turnjoke will run 160 miles over an old wilderness trad that was cut through before this turn of the centurn by a rail-road syndicate but never completed, and will use seven of the old tunnels. Next summer, the Turnjoke will be thrown open to the nation's 27,000,000 motorists, busess, and trucks as a speedy passage-way through the Appalachian Mountains between Harrisching and Putsburgh.

This highway is, however, more than just a super motor road. It has military significance of prime importance. The Turnpike will link Pittsburgh, seat of the nation's vast steel industry, with the eastern seaboard, permitting rapid transport of vital materials in time of war. And although this factor is not stressed by the Pennsylvania Turnpike Commission, it is understood to be one of the major reasons that the Public Works. Administration agreed to underwint £26,000,000 of the road's total cost.

At the instigation of the War Department the Bureau of Public Roads even now is making a detailed survey of this country's 3,000,000 miles of highway system from a military point of view

Super-Highway Across Pennsylvania Follows Old Railroad... Original Tunnels Utilized... No Sharp Curves... No Steep Grades... Speed With Safety

B. F. E. WOOD

ever mindful of the need for rapid transport of troops, guns, and supplies to safe guard our shores from enemy attack and protect inland strategic points

Although Congress has often been told that the countr's present roadway system is adequate for the transported by the country and the country and the country and the may improvements are necessary for movement of heavy artillers and other bulks mittary equipment. Most of the high-speed roads constructed within the last five years have taken this into account, but, the engineers contend little has been done to construct roads thoroughly geared to mittary emergency demands.

The Harrisburg - Pattburgh highway is, primarily a commercial road, but its military aspects have been considered should the need arise for the rapid movement of troops between the two cities. To augment this, en gineers who designed the Turnpike planned for an extension of this new super highway to Philadelphia

The Turnpike was routed so that it could utilize to the hest advantage seven of the tunnels and most of the roadbed of the Old South Penn railroad that was started 60 years ago by William H Vanderbilt and Andrew Carnegie, who sink \$10,000,000 into their enterprise before abandoning it.

Divided by a 10-foot parkway, the Turnpike is the most scientifically disigned thoroughfare ever planned, its engineers claim. By using seven of the abandoned rallroad-project tunnels, the longest of which is a little more than a mile, steep grades are eliminated. The maximum accending grade will be no



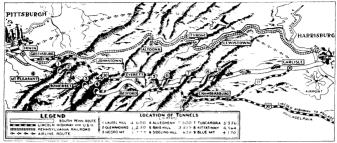
One of the many rubber-shod pieces of construction equipment used

more than 3 percent, and curves will be long and sweeping, with a minimum radius of 1000 feet. This design makes for a degree of sustained speed such as never before has been possible on other highways. Maximum safety at maximum speed is allowed because at no point will a curve loom at the end of a long straight stretch or near the crest of a grade. A minimum of 1000 yard-vision a sassured at all times

With a total length of 162 miles, the highway will pass through many cutand over fills that make necessary the
excavation of 26,000,000 tons of earth
and rock Along the route, the seven
tunnels to be utilized—named for the
mountains which they cut through—are
Blue Mountain, Kittatinny, Tucarora
Sideling Hill, Rays Hill, Allegheny, and
Laurel Hill, Sdeling Hill, the longest.



After a lapse of 50 years, the east portal of Tuscarora tunnel needed clearing before re-boring and widening. The original brick lining seems rather good



The Pennsylvania Turnpike will have great strategic importance—linking our greatest steel center with the eastern seaboard



Steel supports inside one of the re-hored and widened old tunnels

runs 6650 feet. The others average slightly more than one mile in length The old railroad tunnels most of which were only about half finished, are being bored to extra width and height to make way for the wider roadway They will be buttressed with steel beams concrete, and structural glass. The Turnpike, running over a 200 foot right of way, is graded 78 feet wide in the open, and narrows to 28 feet at the en trance to the tunnels. On fills are 10 foot shoulders. In the tunnels, cars will travel on two 1115-foot lanes. Of 176 horizontal curves, only 10 are of more than 4 degrees

Construction on the project is a race against time In orde to quality under the terms of the federal grant, the express highway must be "substantially completed" by June 29, 1940. And the engineers directing the gigantic task say it will be ready for the public by the Fourth of July If the road comes through on time-and with the pace

already set, this seems assured—it will set a record for high-speed construction of high-speed highways.

Because of the necessity for speed in building, the 27 contractors engaged on operations have moved onto the right-of way with the most modern excavating, grading, and road-building equipment Gone are most of the old fashioned steelwheel earth movers. In their stead are some 300 to 400 fast moving, rubber tires, designed especially for this type of big-load operations, measure eight feet in height, weigh nearly 1000 pounds and give increased traction to the large excavators, some of which haud 30 cubb vards of carth and rock per trip

CONTRACTORS on the job report that tribber-bid equipment reduces operating cests as much as one-third and pspeeds up operations so greation so greatly that the highway will be completed in one third the time it oftended by the completed in one third the time it oftended by conditionally would require with less modern solling stock. W. H. Elliott, it is a superficient of the sign for bus, truck, and carth-mover trees for the B. F. Goodrich Company estimated that mover than four-fifths of the machinery used by contractors on the 160-mile highway project is rubber-shod, bringing the total number of units to 1000

Never before have highway builders undertaken to tunnel a roadway through such a mountainous region. The mountains range from 2000 to 3000 feet in altitude in some of the most picture-que country in North America Pennsylvania's other two major highways, the Lincoln and the William Penn, have solved part of the transportation problem in the state, but the rapid increase in traffic left these two roads inadequate to handle the greater volume. The Lincoln Highway crosses the mountainous region with steep grades and sharp curves, and the William Penn follows the winding Juniata River and crosses one range the Alleghen's escapion of Scientific protection is given workers on this giant tunneling project. Although Pennsylvania has no complete dust-control law, the Turnipke Commission is following New York's statute closely with mandatory wet drilling when the dust content of the tunnels exceeds the allowable limit.

Altogether, 114 bridges will be built along the highway, and several viaducts will be necessary to elevate the highspeed Turnpike The 600-foot New Stanton Viaduct in Westmorland County is the largest of these spanning a 1400foot-deep valley. It will carry the Turnpike over two highways, a railroad, and a creek A trip over either the William Penn or the Lincoln Highways involves a cumulative total ascent of 13,000 feet while the total climb on the Turnpike will be less than 4000. In eliminating 10,000 feet of climbing, the Turnpike lessens the dangers of skidding on ice coated inclines

Because of the elimination of steep grades and a shortening of the route over the mountains to the castern sealoard the Turnpike will save up to \$27 for heavy traiter-trucks, the engineers estimate and a proportionate amount for light passenger cars. Toll charges will range from \$1.25 for motorcars to \$10 for the heavest trucks.

Traffic engineers estimated, when the Turnpike was designed, that 1,200,000 vehicles of all types will use the high-speed highway during its first year and 2,000,000 by 1945. This "vardstick" of future super-highways movies every known principle of engineering skill, and the many idea tested in its construction will be valuable to undertakings on an even larger scale. It gives America a send-off to a national network of super-highways to aid commercial, pleasure, and military needs of the ratios.

EVEN THE EARTH ERRS

THE important error in a time piece is its error of rate; it keeps on get ting more and more wrong from day to day Yet, though we demand rela tively high precision of time measure ments, both in practical matters and in scientific work, it is harder to get a good standard unit of time than of length or of mass Experts can construct a standard meter or standard kilogram with the utmost care and of the least perishable materials, compare it as accurately as possible with the international primary standard, and keep it in a vault at the Bureau of Standards, whence it is taken only rarely to test other subsidiary standards But we cannot keep a standard second, or day or year, in a vault at the Naval Observatory to be taken out when we want it. We must catch time on the wing and can measure it only by the motion of some body, which is moving as nearly as possible under undisturbed and uniform conditions. Our best clocks are kept in air-tight cases, in a partial vacuum, and in deep underground vaults, thermostatically maintained at a constant temperature, yet, despite the ingenuity of their design, their readings will not agree for more than a few weeks at a time. It does no harm if one clock runs a little fast compared with the other, so long as it does so at a uniform tate This can be very easily allowed for, but, although such adjustment has been made, the readings of the best clocks begin, after a few weeks, to disagree by much more than the error of recording them

Better things may be hoped from the 'crevial clock' which depend upon the very rapid bit very uniform whathons of a suitably-haped piece of quartz, under electrial stimulus Such a crystal reminds out of the advertisement that was sometimes seen in the days of primitive mechanical refrigeration. "A cake of use nove gist out of order."

But we have a more easily available moving body, which gives us a scale for time measurement which surpasses in uniformity that of any device of human construction—namely—the rotating Farth on which we live

The Larth is very big and very heary, and is rotating freely as it moves in empty space. The attraction of the Sun, which holds it in its orbit, has no influence at all on its rotation, neither has that of the Moon or the planets—with one reservation. The differences of at traction of the Moon or Sun upon different portions of the Earth, which are ent portions of the Earth, which are

Man's Most Accurate Clock is the Rotating Earth but the Earth Goes Fast and Slow... Science Must Keep Eternal Watch on its Subtle Changes

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson
Observatory of the Carnesic Institution of Washington

known as tidal forces, cause the waters of the ocean to move over its surface and these motions, when they produce currents in shallow water, are attended by friction. This friction produces heat at the expense of the Earth's energy of rotation, and therefore tends to slow the rotation down. It can be calculated, however, that a continuous frictional loss at the rate of a billion horsepower would cause a lengthening of the day by about a thousandth part of a second at the end of a century. No humanly con structed clock can even remotely approach this degree of accuracy in run ning Our only chance of detecting so small a change in the Earth's rotation is to compare it with some other motion which is still less hable to disturbance and this may be found in the orbital motions of the Earth around the Sun, and the Moon around the Earth These are affected, in a very complicated man ner, by the mutual attractions of the three, and of the planets But these effects can be, and have been, calculated. and precise allowance for them can be

made

The story has long ago been told in
these columns how Fotheringham, by a
careful study of the records of eclipses
observed in classical antiquity, proved
beyond a doubt that such a change has
actually occurred, and that the Earth,
considered as a clock, is very gradually
running slower and slower.

SINCE the era of telescopic observation began, other moving bodies, such as the inner planets and the satellities of Jupiter, have also become avail able as checks upon the Earth's rotation. The Moon, which moves fastest in the sky, gives the best check.

Now it has been known for a century or so that the Moon's observed motor did not agree exceptly with the best calculations, but these calculations are so mirrear that it was only the classic work of the late Professor E. W. Brown which settled conclusively that the effects of the gravitation of all known bodies had been accurately calculated

But the Moon, compared with Brown's theory, still shows serious and very puzzling deviations, which are not steadily progressive with the time but fluctuate irregularly. Compared with the Moon's motion as a standard, the "clock" based on the Earth's rotation is sometimes fast and sometimes slow. From the most recent discussion, by the Astronomer Royal, Dr. H. Spencer Jones, it appears that, after allowance has been made for the slow progressive change revealed by the ancient eclipses, the Moon was 13' (of arc) behind its calculated position in 1681, 15" ahead in 1785, even with it in 1863, 16" behind in 1898, 10" behind in 1920, and 16" again in 1935. Since the Moon takes 18 seconds of time to move a second of arc this means that our Earth clock was 23 seconds fast in 1681, 27 seconds slow in 1785. 29 sec onds fast in 1898, 18 seconds fast in 1920, and 29 seconds fast in 1935. Dur ing the last part of the 19th Century, it ran fast at the rate of four hiths of a second a year, then it changed and ran half a second a year slow, 20 years later it began to run fast at about the same rate as before The observations suffice to show that these changes took place within two or three years; they can not be made accurately enough to follow the alterations from month to month

Such changes as this can not be explained at all by tidal frection (which can only slow the clock) unless we assume that the friction is usually heavy, and is "let off" at times when the Earth appears to run fast. But any such assumption plays have with the ancient eclipse records, and demands that we believe that gigantic changes in the ocean tides and currents took place about 1898 and 1920, when mariners observed nothing unusual

There is but one solution to the puzzle—found by Brown—namely, that the size of the Earth is subject to change. If the Earth should shrink unformly by one part in a million its rotation would become more rapid, and the day would shorten by two parts in a million—as follows from elementary.

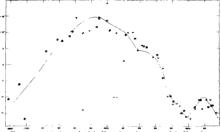
principles of mechanics. The changes in the speed of rotation in 1898 and 1920 amounted to 13 seconds per year, or one part in 24,000,000, so that they could be explained if our planet at the former date (or within a couple of years of it) expanded by one part in 48,000 000 of its diameter that is, by ten inches and shrank back to nearly its former size 20 years later. These changes must have affected the main body of the Earth, and been fairly uniform, for otherwise sea-level would have been al tered along the coasts. No one has any idea what processes in the deep interior of our planet caused them, but the assumption that they happened accounts for the observed facts, and nothing else that has so far been suggested does so at all One check upon the hypothesis is possible. If the "fluctuations" of the Moon's motion really arise from changes in the Farth's redation, and have a mount ordinary time-standard they should reappear in the case of every moving as tronomical body which can be observed with sufficient accuracy. These should all run ahead of calculation, or fall be hind it, in the same years, and by amounts proportional to their own apparent rates of motion

This test has been applied by Jones in his recent paper. The other a stronomical motions available for a test are those of the Earth about the Sun (or of the Sun in the heavens) of Mercury around the Sun, as shown by the times of his observed transits, and of Venus chort the Sun.

The daw usson of material of this sort demands a thorough knowledge of the details of the observations which are considered. For example, the apparent motion of the Sun may be studied deither in an east-and-west direction (right ascrision) or north and-south (declination). The former gives the larger of servable effect, but it depends upon observations of the times of transit of the Sun's limb across the wires of a meridian instrument. (its brightness being of course greatly diminished by suitable screening devices).

peculiarity of the observer in noting the moment when the edge of the great round disk just crosses the spiderthread, may be very different from that which holds good for the same man in watching a star -- a mere point of light -- transiting the same system A great many different observers were at work during the 170 years for which observations were observable, and their unknown personal peculiarities render the observations less trustworthy. The declination observations, though not ideally accurate, are less troubled in this way Again, the observations of Mercury's transits are of greater weight than

those of Venus, in the daylight sky
The net result of Dr. Jones' analysis



Fluctuations in the longitude of the Moon, from observations of the Moon, Sun and Mercury Reproduced from Monthly Notices Royal Astronomical Society

made with his characteristic thoroglines and accuracy is that the condition spoken of above is satisfied. The other relessal motions show "fluctuations" in the same direction and at the same time as the Moon's motion, and these area of just the amount which would result if the Earth, as a clock was wrong to the extent indicated by the Moon's motion. To be more precise, the Moon's motion. To be more precise, the observed and calculated effects agree within 2^{1}_{2} percent. With a probable error of 3^{1}_{2} percent. The evidence that the fault is really with our Earth clock is therefore entirely conclusive.

These conclusions are remarkable enough, and may some day be of great importance to geophysicists, in studies of the deep interior of our planet. To the astronomers of the present and future they assign something more than a "life sentence of hard labor We must keep on observing the Moon's post tion in the sky as often and as accurately as we can "without end, repose or rest. Only by doing so can we keep account of the unpredictable changes of the Earth's size and of its behavior as a clock and only thus can we provide ourselves with a reliable time scale. It is to be like poverty something we dwave have with ne

MIESE observations of the Moon were formerly made mainly with the meridian circle. The difficulties of observing a large disk already mentioned are not quite as bad as for the Sun, but are still present, but the average devia tion for a whole year gives a reliable value. As a check upon these, photographic observations were initiated some 20 years ago. A snap-shot of the Moon, in the middle of a time exposure on the surrounding stars was obtained by a very ingenious method devised by Professor E. C. Pickering. These plates gave accurate determinations, but the necessary calculations were long and costly when hundreds of observations were desired — and the method has been abandoned in favor of a simpler one. This is the old scheme of observing the or ultations of stars by the Moon. From the tabular values of the position and motion of the Moon the exact time at which she will hade a star of known position from an observer at a given spot on Earth can be calculated, and the discordances between these predictions and the observed times afford the desired evidence how far the Moon is ahead of prediction to behind

There are plenty of stars whose dis appearance behind the dark side of the Moon can easily be observed with a telescope of moderate size, and amateurs as well as professional astrono mers can make valuable observations in this way. It is necessary of course, to know the Greenwich time - - or other standard time - at which the star van when with in error of a second at the worst. Before the days of radio this was not easy for the amateur to do, but nowadays enough accurate time-signals are available to enable anyone to check his clock or watch daily or oftener. By collecting and working up observations of occultations, Professor Brown and Dr Comrie of London succeeded, in a very few years and at small expense in doubling the accuracy in which the position of the Moon was known (that is the average amount of its deviation from the tables for a given year). The calculations involved are simple enough but rather tedious but Brown and Comrie found that there were amateur computers as well as amateur observers who liked to work with logarithms, and, when provided with suitable instructions and blank forms, did the culculations for pleasure

Amateur and professional astronomers, in co-operation, are thus adding vearly to our knowledge of things whose very existence was hardly suspected 20 years ago. — Mount Filson Observators February 28, 1944.

Man's Earthly Future

RESUME. In the first part of the present article the author pointed out that the Earth is sale and will remain suitable tor life for many more millions of years. that its present climate is not its typical climate, which has been and will again be more genial all over its surface, that man is an animal and that lew species or animals have lasted more than two or three million years, the average be ing more like half a million years, and that our species, Homo sapiens, therefore should last that long He also stated that must species of animals have gone down because of their inability to adapt themselves to altered environments, but that Homo samens, uniquely, has learned to control his environment through the elever use of material things. He has enough of some things for his use in definitely but at present is using up others, such as petroleum, at a producal

(In Two Parts - Part Two) I THOUGH petroleum affords an excellent illustration of the relation of non renewable resources to the activities of man, it is by no means typical of the items comprising nature's accumulated capital For nearly all of the important non-renewable resources. the known world stores are thousands of times as great as the annual world consumption instead of less than a hun dred times. But, for the few which, like petroleum, are not known to be available in such vast quantities, the story is much the same Substitutes are already known or potential sources of alterna tive supply are already at hand, in quan tities adequate to meet our current needs for at least two or three thousand years There is therefore, no prospect of the imminent exhaustion of any of the es sential raw materials, so far as the world as a whole is concerned, provided our demands for them are not multiplied rapidly in the future

That of course, raises another question Will the dynamid or nor netweakle resources increase materially in the finture and this lastern their established. Becalling the fact that the human population of the Earth has increased almost two field in number in the last 300 years, we might well be fearful on that work which we have a superior of the past and the control of the past however makes it readily apparent that the next few hundred verse will by no means duplicate that record of the past II present trends continue the all-time From the Eaphreenia Barra XI Lecture delivered. The Earth's Natural Resources Should Suffice for Another Thousand Years of Civilization . . . The Outlook for Man is For From Pessimistic

By KIRTLEY F. MATHER

maximum population of the United States will be attained about the year 1970 and will total little more than 150,000,000 souls. Thereafter except for possible influx of immigrants from other countries, no further increase in numbers is to be expected.

Accurate figures are available for mly a few other countries, such as Eng land France, and Germany, but there is a strong probability that the all time maximum for the "white" races will be reached during the last third of the 20th Century and for the entire population of the Earth before the end of the 21st Century Although the human family has doubled its numbers since 1860 it is extremely unlikely that it will ever reach twice its present number of approximately 2,000,000,000. The pressure of demand for non-renewable resources will not, therefore become acute be cause of the increase in population in the near future. Mother Earth is a very wealthy benefactress, and our heritage of physical resources is far greater than ordinarily supposed

THERE is however, another reason why current consumption of nonrenewable resources cannot be taken as the basis for computing the "life" of such stores of basic materials. The demand for automobiles, telephones, ra dios airplanes, zippers, is today very unevenly distributed. Only a small fraction of the human population uses such things in any large amount. Other peoples are beginning to demand them and will do so increasingly as they become acquainted with the "benefits of civili zation" In a few decades, unless we return to savagery, the world demand for many non-renewable resources will be twice or thrice that of today

Taking all these things into consideration it would appear that world stores of needed natural resources are adequate to supply a basis for the comfortable existence of every human being who is bleft, to dwell anowhere on the

'Thompson and Whelpton National Resources Committee Population Statistics 'Vol 1 'National Data p 9 1937 face of the Earth for something like a

Even so, there may be found here an excuse for the policy of "grabbing while the grabbing is spood," which motivates many individuals and nations at the present time. That excuse might, of course, he offset by the suggestion that there is no need to take thought for a morrow a thousand years hence, if we have any respect for the ingenuity of our remote offspring. There is, however, another phase of current trends in human listory that should not be overlowed in the connection.

One hundred years ago, something like 80 percent of all the things man used had their source on farms most of the energy used to do the work of the energy used to do the work of the world came from the muscles of living beings and from falling water. To day only about 30 percent of the things man uses come from things, that grow, most of the energy with which work is done, comes from petroleum and coal one, comes from petroleum and coal been to use relatively less of the annual ancome and more and more of the stored control.

Now comes the change Automobile steering wheels are made from soy beans, piano keys from cottage cheese. innumerable articles fashioned of plastics are produced in part from corncobs and alfalfa, multitudinous metal and rubber substitutes are synthesized from various farm crops. Energy is transmit ted at high voltages for hundreds of miles from hydro-electric turbines A considerable portion of the annual budget for research is being devoted to progress in the direction of using more of the renewable resources-man's annual income and less of the non-renew able resources-nature's stored capital.

What this new policy will meen is readily apparent. With progress along such lines, the pressure for political control of metalliferous ore deposition coal fields, and oil pools is lessened. Much of the physical basis for international pealousy is higuidated. At last the intelligence of science may make it truly practical to beat our "words into ploughshares, our spears into pruning hooks"

Again comes the insistent question from the pessimistic critic Is there land enough? Is there sufficient fertile soil to provide adequate food and in addition the plant materials for the ever expanding chemical industries? And again we hear the same reply Yes, there is enough and to spare J D Bernal computes from apparently valid data that the cultivation of 2,000,000,000 acres of land by the methods now in vogue in Great Britain would provide an optimum food supply for the entire nonulation of the Earth "Two billion acres is less than half the present cultivated area of four billion, two hundred million acres itself hardly 12 percent of the land surface of the Earth in this calculation no account is taken of the increased yields that may confidently be expected from the continuous research of agronomists, plant breeders, and experts in animal husbander and to mention recent developments in the new science of the soil less growth of plants Evidently, the predictions of Malthus notwithstanding mankind need have no fear that mereasing popul lations will place an impossible burden upon the available sources of food. His man ingenuity intelligent use of re newable resources wise admissment of structures and habits to environmental conditions seem competent to dispell that dread shadow

BUT these optimistic conclusions to concerning the relation of man to the non-renewable and renewable resources essential for comfortable existence are based upon world statistics Obviously they do not apply with equal force to the economy of individual na No nation, not even the Soviet Union, Brazil, or the United States of America, embraces within its political frontiers a sufficient variety of geologic structures to give it adequate supplies of all the various metalliferous ores necessary as raw materials for modern industrial operations The United States, for example, must import nickel tin antimony chromium and platinum if American manufacturers are to use those metals in the fabrication of articles essential to what we are pleased to call the civilized way of life. Like wise no nation enjoys a sufficient variety of climatic conditions to permit all kinds of food-stuffs to be grown on its farmand fields or gathered from its forests, and to allow the growth of all the various plants contributing raw materials to in dustry The United States, again the most significant example for us, is forced to import all the bananas, coffee, tea.

camphor, occounts flax, jute quinner, rubber and shellac, consumed in this country, either from foreign countries or its own over seas possessions. It is entirely possible that within a few deades, substitutes of domestic origin may be available to take the place of mans, or even all of such commodities or that plant breeders and agroomists may find a practical way of extending the geographical funities of some of the plant-



"Fossils of two related, extinct animals of the Quaternary Period, 24, 500,000 years ago. The odd one at the left was for a time civilized, in a way of speaking." From an inclingence dated. 25,000,000. A D.

whose products are considered essential so that any nation or upying a large fraction of any continent may actually be self-sufficient. But for the present and probably for a long time to come it is evident that every nation is dependent upon many other nations for the raw materials that it needs for its own in dustrial prosperity.

Perhaps the most important fact concerning the life of man today is this fact of interdependence. No nation, community or individual can gain any last my measure of security without taking that fact into consideration. The resources that man must utilize, if he wishes to escape the fate of his less intelligent relatives now known only by their fossil remains are unevenly distributed and locally concentrated. The techniques of discovering and utilizing them are now fairly well known, but satisfactory procedures for making them and their products available to all members of the human family are not close at hand

The very solution of the physical problems which man encounters in his 7 lbid pp 26-37

attempt to maintain his foothold upon the Earth brings him all the more forcefully into bruising contact with psychical and sorniual problems that must also be solved if he is to continue his existence on this planet. The critical question for the 20th Century is how can two or three billion human beings be satisfactorily organized for the wise use and equitable distribution of resources which are abundant enough for all but are unevenly a attered over the face of the Earth? Clearly, the future of man depends upon finding and applying the correct answer to that specific but far reaching question

Man is not only a specialist in the art of coordinated activity, but the trend toward organization is recognizable in the entire development of cosmic administration Electrons, neutrons, and protons are organized into atoms, atoms into molecules, molecules into compounds, some of the compounds prove to be cells, and these are organized to form individual plants and animals. Latest of all in the history of creative evolution certain individuals have been organized into societies. Transcending all that has gone before is the development of human society, obviously the most difficult, but at the same time potentially the most glorious organization vet attempted

 $\Gamma^{
m WO}$ antagonistic alternatives present themselves as possible bases for this organization. The issue between the two has never before been so clearly drawn as it is today. The social group, whether it be the family the industrial or commercial company or the political unit, may be organized on the principle of regimentation or it may be developed according to democratic principles Both methods are being tried under a variety of conditions, and each has something to be said in its favor. But both cannot be equally conducive to the continuing existence of mankind. One or the other must be selected as the basis for the future security of man

If regimentation by the choice then the great mass of humankind must be trained for obedience - blind, unquestioning, but superbly skilful obedience The educator becomes the intellectual and spiritual counterpart of the drillsergeant in the army. This is no menial task, nor is its objective a mean one Skill is a commodity of which there is never likely to be an over-supply. On the other hand, if democracy be the choice, the great mass of humankind must be trained for wise, self-determined co-operation Precisely those qualities of mind and heart which have long been extolled in Christian doctrine must be developed to the fullest possible extent Not only skilfulness but also the ability to govern oneself, the eternal prerequisite for freedom, must be de-

³ J D Bernal, 'The Social Function of Science New York 1939, p 347

Brooks Emeny, "The Strategy of Raw Materials," New York, 1837, p 26 and chart facing p 29

veloped in each member of the group. In so far as physical existence is concerned, there would seem to be little or no choice between these alternatives. Perhaps, human nature being what it is today, the regimentation of society may temporarily be the more efficient method. But the full circle of organic law embraces more than mere existence. From the continuity of the evolutionary process, there has emerged a creature who is aware of vivid values in life that may be found beyond the goods neces sary for comfortable existence Ideas and ideals are powerful determining factors in the world today, and among them the ideal of freedom for the individual in the midst of social restraint is the most vital and compelling of all Though it buffle our scientific tools for measurement, it is none the less a reality

IT is in the yearning for freedom the love of beauty, the search for truth, the recognition of moral law and in the awareness of spiritual forces that human nature is distinguished from all other sorts of nature. Man shares with other animals, the need for satisfactory economics, for adequate food and shelter, for the goods essential to evisience, but his needs transcend there physical factors because this nature differs from

Regimentation may be good for man as an animal; through that type of social organization his need for goods may be efficiently supplied But regimentation is certainly not good for human nature as thus distinguished Experience veri fies what wisdom foresees, regimentation stultifies the spirit destroys per sonality, standardizes thought and Worst of all regimentation means stagnation of the creative process and, as we have seen, stagnation among the more complexly organized vertebrates has led mevitably to extinction If man attempts to live by bread alone, mankind commits collective suicide Apparently the best and perhaps the only chance for mankind to succeed in the quest for security is through prog ress in the art of living on a high spiritual plane rather than through exclusive at tention to the science of existence on a purely physical level

To put this same thought in more specific terms, it means that coordinated activity directed toward efficient or ganization of individuals must become cooperative activity directed toward the enrichment of personality within an efficiently organized society. This requires both intelligence and good will

Fortunately these characteristics are uniquely developed in the species of placental mammal with which we are preeminently concerned. Man is a specialist in the use of both. The trend of the past 5000 years may well continue, despite numerous temporary setbacks.

throughout the next few centuries at least

It is sometimes suggested that because man has specialized in brains, brains may cause his downfall, just as presumably the overspecialization in external armament contributed to the downfall of certain herbivorous dino saurs. That argument by analogy is however, heavily punctuated with fallacies. There is as yet no evidence that mankind is weighted down with a superabundance of intelligence On the con trary, it is failure to act intelligently that endangers individuals and groups in the midst of competition. To see in advance the remote consequences of contemplated action is an ability which ought to be increasingly cultivated rather than scouted as a menace

There seems to be no good reason why, a sound mand should not be accompanied by a sound bood. If the number of pay chopathe madwiduals is increasing in this high-speed, technologic age, it is a challenge to be met not by bemoaning the immenent collapse of civilization but by melligent adjustment of habits and activates to the new demand of the new times.

The roots of self-centered individual ism may be traced backward for at least 600,000,000 years in the record of geo logic life development, whereas our heritage of social consciousness date-from a time only about 60,000,000 years ago when gregarious instincts became clearly evident among placental mam mals. That trend is however, especially apparent in the group from which man had but stemend.

Man is still in the stage of specific couth. His "golden age" if any is in the future rather than in the past

In thus seeking a satisfactory coordination of intelligence and good will it becomes necessary for research scientists to give more thought than has been customary in the past to the social consequences of their work. They share with statesmen, politicians educators and all molders of public opinion the responsibility for determining the uses to which the new tools provided by sci entific research are put. As scientists they should continue to seek truth re gardless of its consequences and to in rease human efficiency in every possible way, but as members of society, as individual representatives of a species seeking future security as inhabitants of the Earth, they must also do their utmost to ensure wise use of knowledge and constructive application of energy

THERE is a real difference between the so-called "social sciences" and the "natural and physical sciences" that has an important hearing here. It is not that there is anything "unnatural" about the social sciences. Man is a part of nature, and the study of human so-

ciety is just as truly "natural science" in the real sense of the term as any other study The difference arises from the peculiar factors and particular functions pertaining to the co-operative way of life. Whereas the scientific use of things may be achieved through the efforts of a very small minority of the citizens, provided with adequate facilities for research, the scientific organiza tion of society in a democracy can be achieved only when the majority of its citizens have the scientific attitude to ward social problems and act in accord ance with that attitude of mind. In other words, only a few physicists, chemists and technologists are required for the mastery of our physical environment. but for victory in the struggle with ourselves every man must be his own sociologist

Although this places upon the forces of education a Herculean task, it is not nearly so impossible an assignment as at first glance it might appear to be In the first place, the responsibility upon the individual citizen is rarely that of designing a new social structure or charting a new program for society Almost invariably it is his duty merely to select from many plans, programs or proposals the one that seems to him most likely to produce the most desirable re sults for all concerned. In the second place scientific habits of mind have already been developed to a greater extent than is ordinarily recognized. The gar age mechanic attacks the problem of a balky automobile in a truly scientific manner The salesman uses psychology in planning his approach to a difficult prospect. The housewife thinks scientiheally when about to concect a new dessert or redecorate the living room. In most cases, it is only necessary to apply in the area of social relationships the same habits of mind that have been followed in the area of individual behavior

In conclusion, the outlook for the fu ture of man as an inhabitant of the Earth is far from pessimistic. If certain tendencies already developing are encouraged and certain resources already available are capitalized to the full, there is good reason to expect that mankind will maintain existence and even live happily for an indefinitely long period of time The opportunity is his to demonstrate the intrinsic worth of hiologic plienomena and thus to justify the vast expenditure of time and energy involved in organic evolution. With greater emphasis upon the development of intelligence and good will, he may achieve that which the temporarily triumphant dynasties .. the past have failed to achieve. Thus the geologist may turn from the long perspective of geologic history to the enticing vista of the geologic future of Earth and man with high hope and even with confident assurance

FISH HOOKS OF NEW ALLOY

RUST proof and high in strength are fish hooks now being made in a wide range of sues, of "Z" nickel, a heat treatable alloy that is approximately 98 percent nickel. The alloy gives through-and-through corrosion resistance.



After the point is ground, as shown in the photograph at the upper right, a special hand-operated cutter is employed to form the bart. The allow of which these hooks are made is the first available material that combines the quality of being rust proof with the photography of the properties required in manufacturing satisfactory fish hooks.



I Coils of "Z" nuckel were are delivered to the hook manufacturer. The were is first straightened and then cut into correct lengths for the hooks to be made. Then the short blanks are fed automatically over the surface of a grinding wheel (above) where the point is fashioned. One wheel carrect the blanks along, granding wheel is at right angles



3 Right, above. The pointed and barbed blank is now bent around a die to provide the proper hook shape. Separate dies, shown in the left foreground of this pix ture, are employed for the different hook sizes and designs to be produced. At the time of writing, these new alloy hooks are bring made in five different sizes, from tmy flounder hooks to the large sizes used not unto fishing, in the O'Shaughness style



Lett After the wire blunk
has been pointed, barbed
and bent to shape, another
special machine turns the eye
Flah hooks, small in themselves, constitute a miltion-dollar-ayear industry About one
third of the hooks used in the
United States were imported
last year, and most of these
there is no selected to a selected to approach
to the proceed to approach to the proported to capture a large part
of this market formedly setted
by importation from abroad
by importation from abroad
by importation from abroad



While there are several ways of testing hooks, many craftsmen producing high-quality hooks prefer to make their tests by band Experience has taught them to gage accurately the force that each size of fish hook should be able to withstand

Employee Health Pays Dividends

ILINESS is industry, buggest bill!
In the heavy industries, employing,
some 15 million persons, the average
and worker loses about eight days a
year because of sickness. The average
woman worker loses some 12 daws. There
is approximately 15 times as much lost
time from illness and home myjures as
from industrial accidents such as cutand broken bour.

For every day lost by a skilled worker it has been estimated that the employer loses one and one-half, or maybe twice the amount of the worker's daily wage

If we take eight days as the average amount lost yearly per worker and multiply this by the 15,000,000 workers in the heavy industries, we get the staggering total of 120 million lost work days And if we consider \$5.00 as the average daily wage, and one and one-half times this, or \$7.50, as the employer's loss, then we get the dizzy sum of 900 million dollars as industry's annual bill for sick absenteeism This covers only heavy industry, about a quarter of our total work a day population. Nor does this figure include the losses suffered by the work man, the cost of health work sponsored by management, the compensation costs, and the like. Dr C. O. Sappington, in his "Industrial Health - Asset or Lisbility," estimates the total cost of sickness in American industry at 10 billion dollars annually

AIR Hygiene Foundation, an organizaadvancement of employee health, has launched a sweeping study of sick ab senteersm among its 200 member com panies In a preliminary survey Dr A J Lanza, Chairman of the Foundation's Medical Committee, points out that respiratory diseases, notably the common cold, accounted for 44 percent of the male and 47 percent of the female disabilities among employees of a number of companies studied by the U.S. Public Health Service Another source finds that colds alone account for about three lost days per worker Encouraged by the dramatic success of the Safety Move ment in reducing accidental injuries, the Foundation believes that by organized effort, corresponding progress can be made in reducing sick absenteeism

In fact, on an individual basis, numerous alert companies have worked wonders in reducing sick absenteeism by attention to preventive measures and by keeping accurate records of lost time.

R. H. Macy and Company maugurated a new program of preventive medicine Dusts, Fumes, Chemicals, Cause Worker Illness
. . . Concerted Drive Against Such Hazards . . .
Preventive Measures Also Against All Sickness

By JOHN F. McMAHON

in 1926, and has since expanded it. The National Industrial Conference Board reports that Macy's total absence rate from all causes declined 46 percent between 1928 and 1937. The medical department points out that if the company experience for the past 12 years' had been relatively the same as in 1926, there would have been 156 more

deaths, \$21,938 more paid in death benefits, \$347,445 more paid in sick benefits, \$369 more resignations because of poor health, and 631,769 more work days lost

After installing adequate medical supervision, another company reduced lost time by 8000 working days in the second year—an estimated saving of



Sand blasting of industrial products is a highly dusty operation. Workers so engaged are protected by hoods while they breathe clean air through a small base

\$29.094-and by 16.000 days in the third year.

The whole problem of health in industry is as old as industry itself. vet it failed to stir the American mind until the silicosis furore of four years ago Hippocrates, "the father of medicine." was one of the first parents of industrial hygiene. He wrote about the diseases of tradesmen in the 5th Century B.C., describing metal workers as pale and subject to respiratory ills.

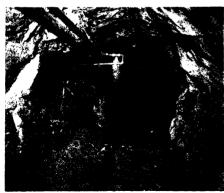
Cleaners and dvers of antiquity used stale urine for cleaning purposes (Because of the foul odors they were forced to work outside the walls of Rome These tradesmen suffered certain infections which Hippocrates described Rome also recognized mining as a highly hazardous occupation Instead of send-ing "public enemies" to concentration camps, the offenders were sentenced to work in the cits. This usually amounted to the death penalty

LONG before the discovery of Amer flourished in the cities of old Europe where boys and frail adults earned their living by removing soot from clogged flues in so doing they encountered chemicals in the soot which caused cancerous growths

Occupational ills are created and then eliminated by the forward march of man Chemicals which were "laboratory curiosities" a few years ago are now sold in carload lots for use in industry. Dr Carey P McCord says some 2000 different chemicals or work conditions may endanger health unless controlled Whizzing power drills replace the time-



Portable air-sampler (electrical precipitator) which registers presence of dangerous fumes and dusts in industrial operations. Note workman's respirator



Compressed air-water atomising spray used for humidifying mine air. This Laird type spray is also used to eliminate dust and gases caused by blasting

honored pick and shovel Spray guns supersede the paint brush These in novations cause air impurities, harmful dust, fumes, gases, and vapors, chiefly responsible for illness in industry.

The Foundation's Preventive Engineering Committee, headed by Prof. Philip Drinker of Harvard, has issued a series of brief engineering "cook books," giving ways and means for combating many toxic substances encountered in industrial atmospheres. such as benzene, carbon dioxide, chromic acid, lead, sulfur dioxide, and others Silicosis, which can now be controlled, is caused by breathing the powdery, flour-like, silica dust arising from many manufacturing processes.

Silicosis gets the publicity-they're even writing poems about it now-but tuberculosis is of greater concern to industrial management. J S. Whitney, studying tuberculosis death rates among men gainfully employed, has found

Occupational Group Death Rates

per 100,000 Professional men 26 2 Proprietors, Managers, Officials 43 2 Clerks and kindred workers

Agricultural workers 46.5
Skilled workers, Foremen 72.1
Semi-skilled workers 98.2
Inskilled workers 182.0

Home and community condutions are assessed Hence community condutions to that disease. Hence some companies extend their medical services beyond the factory gates in the form of community clauses, care of school children, and similar services school children, and similar services Under the able leadership of Dr. C. D. Selby, Ceneral Motors has been doing nine co-operative work with local health departments, to halt tuberculost.

Lead is another health hazard encountered in many trades "Painter's colic" is one familiar manifestation Andrew Fletcher, Vice President, St Joseph Lead Company, and Vice Chairman of Air Hygiene Foundation, tells how his company overcame the lead hazard

"At our smelter there were 64 lead poisoning cases in 1920 in an organization of 400 employees. A study was made on the hazard, and as a result semi-annual general physical examinations and weekly physical inspections were in stituted, a modern change room and a cafeteria were provided Arrangements were made for employees to wear work clothing supplied and laundered by the company, and all employees were advised as to the importance of personal cleanliness in combating the lead hazard A resident doctor not only examined the men, but also made periodic plant inspections to check conditions that might adversely affect health As the result of careful supervision lead poisoning is no longer a problem. As a matter of fact we have not had a case of lead poisoning for the last 10 years'

In 1918, this company had a labor turnover of 250 percent, that means it had to hire 250 new men each vear to keep 100 on the job. By intelligent attention to employee health, working environment, and community conditions, St. Joseph Lead reduced the turnover to 3 6 percent in 1938. To illustrate the economic saving alone, the management figures that it cost approximately \$100 to replace one workman

IN the sintering operating at a Penn sylvania smelter, a dust prevention and recovery plant was installed at a cost of approximately \$26,000 Disregarding the greatly improved working conditions and employee satisfaction. the minimum saving per year is over \$5000, and, therefore, the installation will pay for itself in less than six years But the same plant furnished a more striking example of making money when it spent some \$13,000 in improving working conditions in the furnace basement. As a result, it is estimated that the recovery in the furnaces has been improved by over 1 percent. This saving may seem very small, but it is one which will more than pay for the operating cost of the installations, refund the entire \$13,000 investment in one year, and show a profit of about \$13,000 each year there after

Bunker Hill and Sullivan Mining and Concentrating Company, a member of Air Hygiene Foundation, installed two solariums at its Kellogg, Idaho, operations "Sun treatments" are available for underground workers and towns people Stanley A Easton, President, describes the work this way.

"Repeatedly I have been asked to report what good has been accomplished

in the 10 years of our experience. Such results, while undoubtedly good, are difficult to express statistically, especially in the case of adults School children are brought to the solarum in the school bus in large numbers. Superintendent of Schools John Booth has caused to be kept a record of time lost by the school abildeen on account of illness. He was ports that the children who have used the solarium regularly show far less loss of time than those who take it irregularly or not at all The School Nurse reports the same thing, and that the solarium is almost a specific in the case of eczema and other skin ailments, in improving anemic children and those who lack ap petite and natural vigor. We give about 7000 treatments a month from October until May Adults who take the solarum regularly report in most instances entire freedom from colds and, almost univer sally much lighter colds when they are afflicted. A matron has charge of the solarium for two hours each morning for the use of the women and gurls from whom we have similar reports Pneu monia during the late winter months is often prevalent, and in some years fatali ties are high, records show that during 10 years there has been only one death from pneumonia by a regular user of the solarium, the victim being an old man in poor physical condition generally Some users of the solarum have had pneumonia but in a slight form. The solarium is so well regarded by our people that we were petitioned to put one in at the smelter for the greater convenience of the employees at that plant which is somewhat remote from the mine. This installation was recently completed and is already being used by a large number of our employees at the smelter and their



arises from the
"shake-out" of castings
in foundries. In
this foundry, all the
dust is drawn into the
wide hood
before the shake-out table
and exhausted
through the large pipe
Protograph georger Clause 2

Considerable dust

families. I might add that my own experience largely confirms the foregoing, I take the solarium treatment regularly and am practically free from colds, or any other adment for that matter.

Weary workmen are easy marks for illness and accidental injuries Some companies noticed that accident rates soared in late morning and after noon Westinghouse Electric and other firms barkened back to school days for the solution, reviving the recess idea Now they have "snack periods" when lunch carts wheel through the plants and workmen can get a bite. The "pick me ups" have stepped up production, reduced accidents and illness. One Penn sylvania manufacturer instituted two 15 minute rest periods, one in the morning and one in the afternoon. Although this shortened the work day by half an hour production jumped 20 percent. A Toledo manufacturer who tried the plan reports a 12 percent increase in production des pite a 6 66 percent decrease in working

IT is well known that salt tablets have helped bannsh heat prostations where workmen are exposed to high tempera tures. Glocus, a source of energy, com bats futgue. Some plants make gam ortops available, but one Pathsurgh steel mill had this experience workmen. "Noorfeel" the drops. Instead of eating the candy they took it home to their contents of the contents of

Space forbids listing the many com panies that are active in conserving the health of their employees. The U.S. Public Health Service and U.S. Bureau of Mines also are doing valiant work in this same field. Both agencies are represented on the Foundation's Board by Dr R R Sayers and Dan Harrington. respectively Covernment is increase ingly active in industrial health. Theodore C. Waters of Baltimore, noted authority on occupational disease legislation and member of the Foundation's Legal Committee, advises that 24 states and the District of Columbia have now passed laws granting compensation for occupational diseases Arkansas, Idaho, and Maryland enacted such laws during the past year Meanwhile, commissions have been named in New Hampshire. Oregon, Tennessee, Texas, and Utah to study such legislation and report to their Legislatures this year Some 30 states as well as several cities, including Baltimore, Detroit, and St Louis have established industrial hygiene bureaus. The courts hold, and properly, that the employer is responsible for the health of his employees.

It was the growing difficulty of meeting this obligation that led to the formation of Air Hygiene Foundation. A year before the silicosis sensations of 1935-36, organization details were being worked out by energetic A W Sher-



Fumes from molten lead can be a cumulative, slow poison. The workman shown here is safeguarded by the powerful ventilator at rear which draws off fumes

wood, Toledo glass executive, Dr E R Weidlen, Director, and Dr W M A Hamor, Assistant Durector of Mellon Institute, Dr H B Meller, international authority on any pollution, and a committee of industrialists headed by Roger A Hitchins of Philadelphia The Foundation is a kind of partnership of industry and science Some 200 companies, employing about one million workers, subscribe to the work About half the fundas go in the form of research grants to Harvard, The Saranae Labora cry, and University of Pennsylvania

This research gets down to fundamentals The work at Harvard, under Prof Druker, deals with engineering measures—exhaust systems, for example—for combating health hazards through control of potentially dangerous dusts and fumes

The research at Saranac and Penn deals with intruste medical investigations, such as "protector" dusts that clump with silica and drop it from the air or render it innocuous, the effects of dusts and fumes on lung tissue; and the improvement of X-ray methods for mass medical examinations of employee groups, Dr. Leroy U. Gardner noted authority on silicosis, directs the Saranac studies, while the work at Pennsylvania is under personable Dr. Eugene P. Pen dergrass, one of America's foremosi X-ray specialists.

From its headquarters at Mellon In stutic, Pittsburgh, Air Hygiene Foundation makes plant health surveys for member companies, issues a monthly "newservice" digesting latest industrial health literature, distributes medical, engineer ing and legal information and carries on numerous short time studies and membership services.

Safety would never have scored its triumph on the basis of individual com panies all working independently, how ever fine their unrelated efforts. It was the Safety Movement that did the trick Similar unified effort by employers is a prerequisite of progress in industrial hygiene. Prof Drinker designer of the iron lung, says industrial illness of all kinds is caused by a combination of en vironment and ignorance Employers are steadily improving the working en vironment. Air Hygiene Foundation. through its studies and services, is help ing dispel the ignorance by advancing knowledge on an industry-wide front

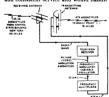
Television Relayed

Makes Possible Network Systems... Test Operation Shows Feasibility... Uses Directional Transmission of High Frequencies... New Tubes

By A. P. PECK

TELEVISION signals, confined as they are to the ultra-short waves. have an inherently short range Regardless of the power of the transmitter, the characteristics of the waves used limit the practical service range to the optical horizon. This brief statement sums up one of the greatest problems which engineers have faced in the development of television for general pubhe use. It is impracticable to establish television networks using telephone land lines, as is done in sound broadcasting The high frequencies and the broad frequency bands demanded by high-quality television transmission cannot be carried satisfactorily on wire lines of the usual design

Thus the engineers have turned their attention to the possibility of radio relay stations which would give satisfactory and consistent service and would handle

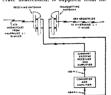


the frequencies needed With such relavs properly spaced, it would become possible to establish television networks whenever and wherever the public demand became sufficient

An experimental radio relay system has been in test operation for nearly a year between the National Broadcasting Company's Empire State Building transmitter and Riverhead. Long Island. Each relay station contains both receiving and transmitting devices, mounted on a tower. The antennas are of the parabolic type necessary for the highly

directional, or beam-like, transmission which the system uses The distance between each relay point, in practical operation, would vary according to the terrain The average distance would probably work out at approximately 30 miles.

Radio relay stations used in the test are located at Happauge and Rocky Point, Long Island, making available at the Riverhead terminal programs sent from the television transmitter on the Empire State Building in New York City. Power for the stations, which operate unattended, is supplied from the

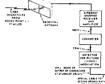


nearby public service sources. In the weent of failure of such sources, the individual station will automatically switch to use of its own emergency power supply, and change back to the first source again automatically when power service is restored. Operation of the relaw stations may be started and stopped by radio signals sent over the circuit.

Development of a new, "inductive" type of radio tube has made possible the reliable transmission of very high frequencies with a radiated power of less than five watts, between relay points separated by 25 to 50 miles. In this tube, energy is derived from a stream of electrons without their coming in actual contact with active parts of the circuit, which gives the device the ability to handle with unprecedented efficiency very wide band widths at extremely high frequencies.

The first relay point of the new system is at Happauge, Long Island Here the television signals radiated from the NRC television transmitter in the Empire State Building, New York, at a frequency of 45 25 megacycles, are received and "detected," to provide the video (television) component, the band width of which is four megacycles This is used to control a transmitter with multi stages of frequency tripling, embodying recent developments in frequency modulation At its first stage of conversion into centimeter waves, the video component is employed to frequency modulate an oscillator producing 526 megacycles, at the second stage, the frequency becomes 158 megacycles, and in the final stage it is 474 megacycles

At the second relav station, the signal is received at 474 megacycles and converted to 100 megacycles, after which it is passed through a multi-stage amplifier which increases its energy to about one watt. This energy is fed to an inductive tube operating as a converter, and the frequency is increased to 464.



megacycles After passing through another inductive type tube used as a straight amplifier in the final stage, the 464 megacycle wave is sent out

At the final station in the relay link, the signal is received at 464 megacycles and converted to 100 megacycles, as in the previous station. After being am plified it is passed on to a second converter, where the frequency is further reduced to 29 megacycles, to provide a more favorable ratio between the frequency and its video component, for purposes of detection. In the process of detection, the signal is changed from its characteristic of frequency modulation to one of amplitude modulation. After further amplification at the video frequency, it is then ready to pass along to a second television broadcasting station, where it may be employed to modulate that station's transmitter, operating on one of the channels, between 44 to 108 megacycles, allocated to television broadcasting service.

The outstanding characteristics of the new relay development are the very high frequencies employed, and the new tubes used to produce such frequencies.

Rail Fissures Give Up Secrets

O NE of the greatest railroad track hazards known today is the internal transverse fissure which occurs in rails. If rails containing such fissures are not found and replaced by good ones, these faults are capable of cassing reputer of rails while in service and possibly disease or result a result of the containing the service of the containing the service of such such rails but those that have occurred faulty rails but those that have occurred

Some years ago the Sperry Detector of Car was developed by Dr. Elmer A Sperry in co-operation with the American Railway Engineering Association. This car was first used in 1928 Its acquipment consisted of a generator which introduced current into the railself of coper brushes—one on each side of coper brushes—one on each side of the car Each of these brush clusters carried a searching unit consisting of a part of electrically opposed coils mounted midway between the current brushes and other car beautiful mounted midway between the current search as the consistency of the car Each of these brushes and directive above the rail head

Current flow was unimpeded through sound rail, but when a fissure was encountered the consequent change in magnetic flux caused a "paint gun" to squrt white paint on the rail at the location of the fissure. Later hand testing of that particular rail found the exact point of the break, and the rail could then be removed

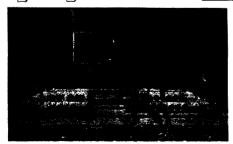
While the idea is not new, such improvements have been made on the detector cars and they have been used so much more widely that remarkable progress has been made in the important husiness of locating dangerously defectve rulab in radiroid tracks. For example, in 1934–22.81B defective rails were found in 41151 track miles—an average of nearly one had rail in every two miles of track. In 1955, 25.437 such rails were found in 01,860 track miles, and a steady norreas—was made through the years to

The early Sperry searching unit had two pairs of coils-in line (Figure 1) It often missed fissures to one side Modern type (Figure 2) has multi-tandem, stagbrush carriage of detector car Between two sets of curbrushes is searching unit. Right At the paint spot, a hand searching unit, two iail contact points, and a meter mounted on rear of ar, determine size of internal fissure. Each rail flaw, indicated by a paint spot, will be examined in this manner



Multi-fissured rail is the most dangerous of track defects. Nearly 12 percent of fissured rails found are multi-fissured. Four transverse fissures, were in this two foot, piece





1939, for which year the figures were, respectively, 47,966 and 82,250 During the 11 years from November, 1928, through December, 1939, the Sperry Railway Service has tested over 549,000 track miles and have found over 279,000 defective rails. This is indeed a startling record

In greeord How moptant is this testing for rails which might cause wrecks is shown by the fact that trains have been speeded up tremendously in recent years, the rails must early flexible tools and area of the fact that the state of the st

Making Tissues Ageless

O NCE it was thought that aging is a universal characteristic of hife — and that, in order to live, it is necessary to age. Now, to every one's astisfaction, it has been established that at least small portions of the body may be kept alive endlessly, agelessly. Man has discovered the secret of immortality—for bits of tissue, at least A fresh nutrient medium keeps tissue fresh, youthful growing. Every passing second does not necessarily leave an indible imprain on living field.

For more than a half-century, it has been possible to maintain life, for varymg numbers of days, as strips sliced from bodies dying but not yet dead throughout Human flesh, still living even if cut from a body legally dead, will more or less lengthily stay quick in dilute salt solution very similar to seawater, hence very similar to the salt solution which floods our veins. Or such bits immersed in plasma - blood minus corpuscles -- will likewise cling amaz ingly to vitality More than 40 years ago, human skin was held alive in tissue fluid, for weeks, and then successfully transplanted Then, within the next few years, cancer tissue was being cultured in dog blood, also for weeks

IN 1907, Ross G. Harrison reported a simple but revolutionary technique whereby bits of tissue can be made to live for several weeks outside the organism. He took lymph from a young animal and touched drops of the fluid to the under-surface of small, extremely thin, glass plates. The lymph drops clung and clotted Into the clots he introduced fragments of embryonic tissue He protected each culture by suspending the hanging drop over a small depression in a glass slide. And, as the days passed, he saw nerves grow out through the clots -- grow from embryonic nervous cells. In a drop whose minute bulge looks down into a glass hollow, many a mystery of life is discoverable. Thus at the very outset, Harrison taught men that a nerve cell can develop its own conducting thread, or axon

Thus also be gave a limit to the genius of Alexis Carrel It has been the genius of Carrel to extend indefinitely tae life activities that can go on in a hanging drop. And Carrel has invented flasks and fluids at last achieving the perfect result—artificial immortality of minute groups of cells.

In either hanging drop or flask, a coagulum is prepared from blood plas-

Experiments on Tissue Cultures and on Portions of Plants . . . Suggest Promise of Artificial, Earthly Immortality . . . Direct Bearing on Medicine

By BARCLAY MOON NEWMAN

ma A liquid nutritive mixture mast also be provided if extraordinary precautions are taken against infection with microorganisms, and if the bit being cultured is transferred every two or three days to a fresh, sterile medium, ageless life is gained Growing tissue must be chopped in half at the time of transfer, otherwise the mass of cells becomes too bulky to permit inflow of nutrient and outflow of waste A living mass merely in the state of survival, rather than in some phase of growth, needs no slicing.

In 1912, Carrel cut a tiny piece from the embryonic heart of a chick and immersed the fragment in warm, nutrient bed, plasma being the source of nutrient as well as coagulum-support Then commenced a regular series of transfers to regularly prepared, fresh medrum But the bit of connective tissue. though maintaining its life, slowly dwindled and promised eventually to perish, after several months in the series of flasks. The seeker after terrestrial immortality thereupon thought to test the influence of fluid extracted from chick embryo - embryonic tissue extract Success! The long-living fragment began to wax as its cells multiplied healthily Consequently, this discovers, plus an almost infinite capacity for taking pains, means potential immortality for numerous sub-cultures of the original piece of connective tissue from the chick's embryonic heart. As Carrel tells us

"The cell colonies remain indefinite ly in the same state of activity. They do not record time qualitatively. In fact, they are immortal."

Ageless they will remain, as long as laboratory assistants care for them

Recently, new methods have been in roduced for the cultivation of larger masses of tissue, including human tissues of practically every kind, especial by tumor cells. In 1936, G O Gev and M K. Gey reported their invention, the roller-tube system, for the maintenance of human normal cells and tumor cells in continuous culture. Than-walled test tubes are used, their walls being coated with plasma to which the living colonies adhere. Nutrient fluid within the test tube battes the filmy layers of cells test tube battes the filmy layers of cells.

¹ Carrel, A. Physiological time, Science 1929 618 December 18, 1931



An operation for removal of a tumor. After removal the tumor can be cultured in a special medium (see text) or transferred for culture to a living animal



One of the steps in tissue culture, conducted under sterile conditions

-- streams over them as a motor revolves the test tube rack six times on hour Fresh fluid is provided after four days Transfer to a fresh tube, with new coagulum, is effected after a week or a month, depending upon the nature of the culture. Other techniques, devised by Carrel and Raymond C. Parker, at the Rockefeller Institute for Medi cal Research, New York, by W. H. Lewis and several other pioneers, permit a wide choice of procedures by which a large variety of animal, including human, cells may be given deathlessness far beyond - indefinitely beyond the present average span of life of the whole creature Terrestrial immortality for almost any part of the human anatomy is nowadays only a question of money to cover the cost, which is high

THE methods are sure and, moreover, are steadily being improved, as the vast and growing list of valuable discoveries bears witness. At the Strangeways Research Laboratory at Cambridge England, from embryonic dental tissue whole rat- or rabbit-teeth are grown. without the jaw being present. If human tooth-germ cells were available, from these microscopic specks entire human teeth could be synthesized in the test tube - the main factor being merely the appropriate nutrient mixture Factors controlling the production of blood corpuscles, controlling growth itself, controlling the rate of wound bealing, regulating cartilage development, factors regulating success in grafting - an apparently endless list of factors - are being measured and evaluated. All medicine benefits

The relation between blood pressure and the thickness of the arterial wall is being elucidated, to the benefit of the considerers of arteriosclerosis, great tragedy of older man. "In grafting experiments with tissues derived from races of different size, genetic rather than immediate factors have been shown to be the more influential," the editors of the British Medical Journal (December 31, 1938) relate. They con

"The Strangeways Laboratory is now even better equipped than before for studying the effects of radiation, and work has been done on the degree of susceptibility to X-rays of different processes in cell metabolism. The factors controlling the effects of graduation have been studied in tadpoles, and the results appear in several ways to confirm the long-held belief that meta bolic activity and in particular the imminence of cell division, determine the suscentibility of the cell to irradiation. All the work has evidently a fasconation in that it deals with living material which is yet under complete con trol

The editors could add that these determinations have direct bearing on medicine of today and tomorrow exto-ding the practical limits of gratting learning the man secrets of success in treating cancer by irradiation finding the means of molding tissue cultures to the plan of man rather than of a wild Nature. And in the background is the stupendous basic discovery, tissue in glassware can by man be cultivated limitlessly. Further, as we shall see protoplasm's plasticity can be in glassware more astonishing than anywhereelse.

By a method distinctly different from tissue culture, it is now possible to give agelessness to life, for very long if not endless periods. Animation may be suspended indefinitely by careful freezing and subsequent maintenance of a contant very low temperature — minus 70 degrees centigrade Whole organs or whole animals cannot so be preserved alive — at least as yet. But practically any type of cellular mass, if not too large, may be frozen and after long perriods revived successfully At Cornell University, C Breeds and J Furth have been keeping all sorts of cancer tissue frozen for as long as a year without any diministion of virulence after the thaw

Cells lining the windpipe have heating, haselike cilia. Breedis and Furth froze chicken's chiated cells. After 327 days, warmth made many cilia heat again, as though in the animal's wind pipe.

Tassue to be frozen is removed imme dately after the animal is killed It is miniced in nutrient solution and placed in small test tubes, which are then easied with a flame. Storage is under alcohol in a Thermos bottle containing large pieces of solid carbon dioxide ("dry ice"). The thaw is effected by shaking the test tube in warm water. The secret lies in slow freezing, rapid thawing, otherwise, death results.

HOW long may life exist as suspend-ed animation, frozen? Nobody knows P Ehrlich has found cancer cells still living after two years, though stored at the fairly high and unfavorable temperature of minus 8. Research is actually just beginning in this line New ways are being tried. And even present ignorant technique serves to store frozen life indefinitely, ageless Nevertheless, the point here is not mere ly the potential development of perfect agelessness though suspended - frozen - animation, it is, further, the obvious, additional aspect of the lability of life. life so modifiable by man As the decades and the centuries pass, proto plasm's plasticity will emerge as a consideration far vaster in import than any possibility of artificial immortality

Plant-tissue culture too is practiced Carl D. LaRuc, of the University of Michigan, is able to tell us

"In the course of recent work. I have observed numerous examples of a surprising length of survival of plant its use. Various parts of flowers were detached and placed in sterile culture on nutrient agar. Some of these parts have undergone no regeneration and have shown no significant growth but have lived many times as long as similar structures on normal plants. Most of the structures were still vital at the end of the recorded period."

Petals of Tradescentia paladosa fail into decay within a day or two after flowering. So it goes in Nature, but not in LaRue's laborator "In culture they remained alive for an entire year" Sus pended animation? Probably not, rather was normal life abnormally maintained Youth and beauty need not fade—not so soon, even today Tomor row?



MONTHEL DIO

Conducted by F. D. McHUGH

GLYCERINE FROM

CLYCERINE is witally important in a wide range of industries. This sweet and viscous liquid is a by product of the soap industry and the quantity available is more or less fixed, depending, of course, on soap production. Unlimited quantities of the compound can now be made from petroleum, according to a report by Dr. Evan C. Williams, Dr. H. P. A. Groll, and G. Hearne of the Shell Development Company. This new process may go a long way to toward preventing the will deal unnecessary with the compound of th

In the new process, propylene, a gaseous component of cracked petroleum, is acted upon by chlorine to produce at low cost allyl chloride. Trichloropropane is readily prepared from that compound The molecule of trichloropropane is similar in structural design to that of glycerol (or glycer ine), and the product is readily convertible into glycerol with the aid of cheap alkah.

ELECTROSTATIC IRON ORE SEPARATOR

ALABLE percentage of rom still remines in rom or discated at the mires liceaue of too low a concentration for commercial separation. To prevent this waste an experimental electrostatic separaof much higher operating speeds as well as more efficient and effective recovery of iron. When this vs. perfected and put into use a more discard and the properties of the properties of the more efficient and efficiency economies.

New Locomotive Record

A EW all time world record for continuo on staironal documeiros performance is believed to have been set on February 28 when Diesel electric locimistic No. 56 pulled -nto Washington with the Capital Charited othe Baltimore and Ohn Baltroad. This arrival marked the 365th daily run of the locimistic between Chicago and Wash the control of the between Chicago and Wash than 280,000 miles. So far as its horse-condition of the control of the c

Contributing Editor ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

The record is regarded as being the more remarkable because it was made on a 722 mile run calling for regularly scheduled average speed of more than 56 miles per hour moduling for regularly scheduled stops—over a route which includes some of the heavest mountain grades in the easiers see too of the country. The Lapito Limited to regularly consists of from 11 to as many as with the property of the country with the property of t

STATIC-FREE RADIO SETS

R ADIO manufacturers will soon aumounted high fidelity, radio receiving sets equipped to receive programs transmitted by stations that have adopted the Arentsong system of wide swing, frequency modulation broad casting. The sets will be designed to receive present standard band broadcasts as well as programs broadcast by stations ecuipped.

and licensed to use the patented Armstrong frequency modulation transmitters.

Claims for frequency modulation by Mapor Edwin H Armstong, widely known radio engineer and inventor, include full missical lone-range reception without distortion, and elimination of natural and mande state. The development of frequency modulations broadcasting and reception during the last I2 months has reached the present of the control of the con

BENZEDRINE IN

ALCOHOLISM

THE treatment of alcoholum is more and more being understood as properly be longing in the realm of psychotherapy, even though the practitioners of this branch of medicine are somewhat discouraged by their efforts. The chronic alcoholic addict has a fundamental personality defect which is a fundamental personality defect which is a transplant of the contract of th



Holder of an all-time world record for continuous service

quickly and effectively by the judicious use of benzedrine sulfate.

According to Refensien and Davidod, who have investigated the action of this drug in mental states characterized by depression or self-shooptoin, active alcoholic psychoias and Korakkow's syndrome in also helica respond well to the use of amphetine sulfate. Acute intoxication, with its attendant boaterousnes, can be made to disappear rapidly by the use of this drug A and charonic alcoholium. When the natural and charonic alcoholium. When the natural is institutionalized, the results are even more striking.

These authors impress us with the futility of this drug as a cure for addiction to alco holic beverages Somewhat analogous to vitamin B deficiency therapy in the treatment of alcoholic polyneuritis, benzedrine sulfate merely improves the psychotic and physiologic aberrations which attend acute intoxication. Neither has any effect in altering a habitual tendency toward inebria tion Reifenstein and Davidoff cannot agree with Bloomberg who found that the use of this drug in chronic alcoholism permitted a sufficient period of sobriety for the in stitution of psychotherapeusis Nevertheless, it appears that this drug has a definite place in the therapy of some phases of acute alcoholum - N. V. State Journal of Made

PORTABLE DEVICE DE-ODORIZES AIR

A NEWLY invented portable odor adsorber, employing the principle of the ordinary gas mask, is now available for removing unpleasant odors, gases, vapors, ampke and tumes from the air of theaters.



The fan draws foul air through the cylindrical container, where it is purified and delivered to the room

restaurants, offices, factories, hospitals, lavatories, and other places of human occupancy. The device, known as in Dorer. "Squirrel Cage" Odor Adsorber, is simple, compact, and has but one moving part—the electric motor which draws the foul air in, purifies it, and delivers it back into the room.

Employing the positive extraction principle of air-odor removal, the Decix unituses an adsorption medium composed of a specially proceeds, highly actived, granular, occonut-shell carbon. One of the most able to adsorb and hold all condensable owner, the adsorb and hold all condensable content. This activated carbon is contained in a cylindrical cage of closely spaced, perforated metal cylinder.

Two types of these new units are offered by the makers, the Dorex Division of the W. B. Connor Engineering Corporation—one



Preparing pineapples for canning at a rate of more than one per second

for installation on any wall or ceiling where it occupies little more area than an ordinary fan, and the other to be applied to any existing ventilating or air conditioning systems.

RAY-ABSORBING GLASS

AMONC the many types of gluss are developed in recent years as a unique one used in welding. It attannitis only 37,0,000 of 1 percent of visible light, which is sufficient of visible light, which is sufficient visible light, which is sufficient visible light, which is sufficient to the sufficient of the ultra-violet, which is harmful to sight, and all but 1 percent of infrared Twenty-five years ago, only one commercial welding glass was swall-side and this shorphed only 15 per

PINEAPPLE PEELER

DFFORE the new Gnuce mechine was becaused in puneapple cameries, these Hawaiian fruits were peeled by hand. A good fast worker could swersg only three or four fruits a minute. Now, the largest camery in the world, by using 46 machines, has a production record of preparing the first and packing 2776 cans per minute. This totals 3,497,388 cans per day or a car do every two and one-half muntes.

In 1910, an inventor named Henry Ginaca was hard at work on a machine which would peel the skins from pineapples. His aim was to do away with the slow and costly hand method.

The first Gnace machine quadrupled the unique I state and the fruit, the machine shaped it is uniform area for the manner. By constainly improving the machine, the number of operations at could be perform was increased, as well as the speed with which it worked. By 1913 the Gnace machine was peeling more than 30 fruits a minute; it sized them, took off the ends, and minute; it sized them, took off the ends, and carried them, took off the pineapple meat from the dame.

The present Ginaca machine can prepare from 85 to 100 pineapples a minute, depending on the size, and do it more perfectly than by hand. The shells are removed, ends cut off, the fruit is sized to uniform roundness, the core is accurately extracted so the hole is in the exact center, and the meat is scraped from the shell.

When Mr Ginaca first got the idea for his invention, he was employed by the Hawaiian Pineapple Company Now this concern uses 46 of his improved machines

FIRST COLCHICINE-MADE

NEW flower, Tetra Marigold, which is introduced this spring to American gardens, is unique from the scientific, commercial, and horticultural angles. It has the distinction of being the first flower produced for cultivation which was developed by doubling the chromosome number by artificial means. David Burpee, plant hybridist, reports that in experimental work at the Floradaie Farms, Lompoc, California. dozens of species of plants have been used in our experiments to double the chromosome number through the use of colchieune In many instances, no results whatever were achieved. In other cases, tetraploids were produced which were definitely inferior to the original plants. In other instances, larger and more rugged plants than the



Burpee and Tetra Marigold





Two views of the experimental set-up for testing aircraft fire-fighting equipment

diploids on which the work was done were produced, but the first one to respond satisfactorily to the treatment on a large scale is the new Tetra Marigold, produced by treating the most popular variety of African Marigold, Guinea Gold Seeds of the new flower are now available

Tetra Marigold has larger flowers of a more intense grange than Counce Cold and the petals are frilly and possess unusually heavy substance which assures longer life for the flowers after cutting. The plants grow two to two and a half feet tall and are very vigorous. The main trunk and branches are thick and heavy, while the flowers are borne on short stems in clusters of six or eight on the end of the branches, each branch making a bouquet in itself when cut Blooms appear in about 19 weeks from the time seed is planted, and the Tetra Marigold is as easy to grow as other Marigolds - C F Greeves Carpenter

BABY CLIPPER

PiPER Aircraft, manufacturers of the well known Piper Cub, have undertaken an ambitious experiment by building a Baby Clipper One of our photographs shows a trim little amphibian which, equipped with a 75 horsepower engine, crosses at 92 miles per hour, carrying two occupants and 50 pounds of baggage The stalling speed is 45 miles per hour, and the cruising range is said to be 600 miles Gross weight is 1500 pounds, wing area is 180 square feet If small private land planes have reached such a high degree of popularity, then it may confidently be expected that a small amphibian or flying-boat, moderately priced, will be received with equal enthusiasm by private owners - A K

AIRCRAFT FIRE PREVENTION

THE Aircraft Section of the Technical Development Division of the Civil Aero nautics Authority (the correct, if unduly long, title) is pioneering in co-operation with the Bureau of Standards in the field of fire prevention in the aircraft power plant Aeronautical research has a way of centering on the beauties of aerodynamics and structure and it is gratifying to see attention being given to less "beautiful" but equally essential research.

The general program involves the investi-

gation of hre detectors, hire extinguishers, fire-resisting materials, and fuel and oil tests is in progress with co-operation of all interested manufacturers

The experimental set up is indicated in two of our photographs. The power plant unit consists of a Pratt & Whitney Twin Row Wasp with a controllable, three bladed Ham ilton propeller Back of the power plant is the nacelle and wing in almost full scale A wind tunnel will draw air in through a large opening, and will give a blast of 75 miles per hour on the power plant

In the test program it will be possible to vary the speed of the blast of air, the in tensity of a simulated fire, the location of simulated fire the type of fire extinguisher, the type of fire detector -A K

FLIGHT DURING LIGHTNING DISCHARGES

he Journal of the Aeronautical Sycances, E. J. Minser, meteorologist of W A, discusses this subject with a wealth of experience and observation to back his views Modern metal airplanes, (arefully bonded and shielded, suffer little structural damage when struck by lightning though there is always a hazard. The first

lightning discharges encountered were gen erally considered freaks of nature "one in a million" events. But as their occurrence became more frequent, a general warning

NON-STOP

AERONAUTICAL engineers prediet that within 18 months airplanes will be capable of flying to Europe with a full load and returning non-stop if necessary

was issued to pilots to keep clear of thun derstorms This warning, wise as it ap peared, did not decrease the number of disharges encountered Analysis of such events soon revealed that the majority of discharges were not being encountered in thunderstorms but occurred in "cumulus" type of clouds that produce showers. The results of the investigation indicated that the airplane "triggered" a discharge be tween two cloud masses

As soon as it was determined that the initiation of a lightning discharge through an airplane in flight requires the passage of the plane between two oppositely charged portions of a cloud, much more specific in structions were issued to pilots

1 Avoid, if possible, instrument flight through large cumulo-type clouds, especial ly when the temperature is between 25 and 35 degrees Fabrunheit

2 If temperature and degree of static and corona discharge indicate the presence of a highly charged zone, reduce speed and

3 If change in altitude is not possible.



A Baby Clipper, designed for the popular-price class

keep eyes focussed on the brightly lighted instrument panel. This will prevent temperary blinding if a discharge occurs near the cockpit -A K.

SYNTHETICS

O RGANIC chemists of the world made approximately 25,000 new chemical compounds last year, an increase of about 6 percent

PRESSURE COOKER SAUCE-PAN

THE many advantages of pressure cook ing in an alumnum vessel have been incorporated into a standard alumnum sauce-pan by Vischer Products Company Made in four sizes from one to four quarts, the Vischer Plex-Seal Pressure Cooker cooks tooks in a fraction of the time ordinarily looks in a fraction of the time ordinarily



required It enables the housewife to use cheaper cuts of meat satisfactorily, and boasts the well known good qualities of aluminum cooking utensils. Meats and vegetables retain their color and vitamin content when cooked under pressure

The new pressure kettle has no hold down holts, gages, and extraneous ragging, yet holds a pressure of 15 pounds safely. A thin, strong metal cover is inserted within the lips of the kettle, and is held down by an ingenious and easy to fasten hook. As

steam pressure is built up in the kettle, the cover is held down more tightly, and pressure-cooking takes place.

SELF-POWERED

HAND STROBOSCOPE

As explained in our February article on Astrobasopes, "Supping Time," a rapidly rotating, whraing, or oscillating object, seen very briefly at the same point once during each cycle, appears to be monest before the same point once during each cycle, appears to be monest before an impression is made upon the return of the eye and is transferred to and returned by the brain until the next glumps This phenomenon, known as "persistence"



Self-powered stroboscope compared with baseball for size *Upper* right The instrument in operation

of vision," has been used for years in various types of stroboscopes, from the ordinary soluted disk type to the type which flashes a light at regular, fast intervals to illuminate the moving object at one particular point of its cycle. Commercial stroboscopes have depended mainly on the latter principle of light flashes.

In the Strobomeca, a development of Boulin Instrument Corporation, the slotted disk principle is utilized in a hand instrument which is self-powered, requires no electricity of any kind, either from batteries or wire connections. This new device contains a Chronometric motor which drives a slotted disk. The speed is accurately controlled by a spring governor The motor, wound by a permanently attached key, the disk, protected by a heavy glass panel, and the governor are contained in a three-piece threaded aluminum housing slightly larger and heavier than a baseball. In use, the instrument is wound and focused on the moving object and then synchronized with the motion of the object, the speed of the object then being read on the instrument's graduations



The range of this instrument is from speeds of 500 to 100,000 and it may be used at the plant, in the field, indoor and out. No accessories are needed. It is claimed that the accuracy of the spring-wound movement has proved its durability in endurance tests of over 100 hours.

FREIGHT-FUEL

FOR every thousand tons of freight and equipment moved one mile, American railroads now use 112 pounds of fuel compared with 172 pounds of fuel in 1920.

PAINT FOR HOT METAL

H OT metal surfaces are as subject to trust and corroson as are cold ones but no ordinary paint can be used to give them proper protection. A new chemical post-presenting paint, named Kennick, last the proper paint, paint considerable to the control paint of the control paint. This finally, which is made by the American Chemical Paint Company, may be used on hot parts of the automobile engine, such as chaust manifolds, exhaust pipes, and mufflers. Not only will at protect the metal but it also makes a more aughly engine.

Kemick becomes effective through themsels action with the metal which it is covers. Whereas ordinary manifold and engine enamels decompose quickly and completely when subjected to heat, Kemick decomposes only partly, the volatiles are expelled, and chemicals are hierarchied to react on the metal surface. It does not burn off but retains its color and protective properties and is said to improve with heating

A PANCAKE-DESIGN

DIESEL ENGINE

POR reasons of economy of space, primarily, certain gasoline engines have been built with all cylinders horizontal, in what is known as a pancake design. These have the important advantage of conserving space by being installed flat under the floor of truck bodies.

This design has now been applied to Diesels by the Hercules Motors Corporation in a series of high-speed heavy-duty engines. They were developed particularly for applications where limited space requires engines of limited height. Naturally, in placing Diesel cylinders horizontal, much attention had to be pead to a number of special probability.



Space conservation is one advantage of the pancake-type Diesel

SCIENTIFIC AMERICAN



Sheet-metal forms are made by stretching on this press

of descred.

lems involved, but it is claimed that these were all solved in this design. The three models in the present series are of 176, 191, and 193 horsepower respectively

SILENT

LAWN MOWER

MODERN lines and silent operation are the outstanding features of the 1940 Marathon lawn mower styled by Glenn W Tammen of Designers for Industry, Inc., for the F & N Lawn Mower Company



This modern mower will be approved by users because of its lightness and ease of operation, and by owners and neighbors alike because of its silent operation. Wheels and reel spiders are of the disk type Practically all parts, except the cutting knives, are zinc alloy die castings - light, tough, and practically unbreakable. The wheels are equipped with oversize tires having a "full power" tread which is also a feature of the rubber tread on the roller

METAL STRETCHING PRESS

INSTALLATION of the first metal stretching press to be built and operated in the United States has recently been completed in the huge Middle River plant of The Glenn L Martin Company Built by the Engineering and Research Corporation from Martin specifications and first installed by the Martin Company, it is now being used daily

Primarily, the machine consists of two hydraulic cylinders placed beneath a platen between two rows of independent clamp jaws. The cylinders are attached to the platen in such a manner that they raise or lower the platen vertically The cylinders then operate in tandem, making it possible cipally through absorbing work which eace required the use of hand tools, making it possible to turn out the work on a production basis.

The press does not in any way take the place of the drop hammer, but it appears probable that some parts that are now formed on the drop hammer may in the future be successfully manufactured on the new stretching press

FOUNTAIN HUMIDIFIER FOR HOME

THE electric fountain humidifier is the newest development designed to aid in maintaining proper humidification of the air in the home. This ornamental device.



shown in an accompanying illustration, operates from a 110 volt, 60 cycle, alternat ing current line, and needs no water con nection. Its sprays, which are pumped in a circuit, use approximately a pint of water per day. The device uses only 30 watts of electricity which is no more than a small

electric light uses. The humidifier is made of heavy spun aluminum and comes in five attractive colors- bronze, chromium, copper, red, and green Except for a soft splash of water,

The stretching press is used principally for the forming of large sheets, such as skins, engine cowlings, and so on, which were formerly shaped on a power hammer It fills a definite need in the industry, prin

to obtain an angular position of the platen

In operating the press, a form is placed on the platen. The sheet of metal to be

stretched is placed over the form and clamped tightly in both rows of jaws Pres

sure is now applied on the hydraulic cylinders, causing the platen to move up-

stretching the sheet tightly over the form

stretched so that it huge the form tightly,

the pressure is released and the formed

piece also released from the block. It is

interesting to note that in the stretching

process the thickness of the material is

reduced only 5 to 7 percent

When the sheet has been sufficiently



Furniture is now being made from woven strands of synthetic plastic. Tenite, an acetate butyrate plastic developed by the Tennessee Eastman Corporation, is extrusion molded in continuous lengths and woven like reed or rattan for lawn settees, chairs, and tables. A crystal-like matting for wicker-type furniture is machine woven from narrow, transparent strands. Chairs of a more rustic type are hand woven from wide, flat strips of bright, translucent colors. Woven plastic seats have a slight springiness; the smooth surface cannot tear sheer frocks or seats nave a single springures, the samous behave called and rain for weeks and then immersed in hot water for 48 hours, showed no deterforation



the device is noiseless. It will not cause radio interference and the manufacturers claim that it cannot leak or get out of order.

DEADLY WIDOW

THE venom of the black widow applier is approximately 15 times more potent than that of the rattlesnake. Hence, the principal reason more deaths are not reported from black widow bites is that she is a timid creature and bites only when cornered.

GLASS MARKING INKS

GOLD Seal Laboratory laks for labeling annil glass surfaces used as mucro-cope alides and small containers are a scient offering of the Clay Adams Company. These are ready to use with steel pen, by the stamp, and write as finely as paper nike. They are non-acid, non-ror rowse, non-infammable, and resistant to acid, alikali, usual laboratory solvens, and high temperatures. They are recommended as well for purcelain refractories and other highest properties. Calors are red, white, they and they have a distributed to the commended as well for purcelain refractories and other medium of the commended as well for purcelain refractories and other commended to the commended as well as the commended as the c

INSTRUMENT FOR GIVING SEX HORMONE PILLS

A NEW instrument for depositing "banks" of male sex hormone within the body, in a painless injection in the doctor's office without need for surgical operation, has been described by Drs. Samuel A Vest and John E. Howard in the Journal of the American Medical Association

"Hormone banks" are the latest method of supplying sex or other gland products to patients lacking a supply of their own Young men cheated of manhood by a nutake of nature have been given virility by this method, and Addison's disease sufferers have been restored to healthy, normal lives by the state of the supplements of the suppleme

Instead of injecting a fluid preparation of the hormone, solid pellets of the material have been buried beneath the skin by surgical operation. The pellets form "bormone banks" on which the body may draw as the material is needed. Several months' supply can be given at one time.

The new instrument now makes even the surgical operation unnecessary. In the doctor's office, a wheal is made in the patient's skin by a local anesthetic. The injector instrument, containing the desired supply of hormone pellets, is pushed painlessly through the skin. The pellets or pills are ejected from the instrument, which is then withdrawn.—Science Sersies.

GARAND RIFLE MODIFIED

THE U. S. Army's new self-loading Corand rife, new in quantity production, has had its muzzle end slightly modified and simplified, to support the bayonet more solidly. A number of munor adjustments have been found necessary in the quantity-manufactured rifles that were not apparent in the earlier rifles produced by slower, small-scale methods, but no major faults have been discovered

Ordnance men hoot at rumors that the Garand can't "take it" under field condi-

CHAMPION

of Star-Gazers

by Westinghouse



• They're building an eight-story telescope out at Mt. Palomar in California. Its mirror, as you probably know, is 200 inches across... weighs 20 tons.

This gigantic optical device has a seeing distance, in miles, of — well, put down a 6 followed by 21 cyphers. For handy use the astronomers call that distance one billion light years.

- But a telescope is a great deal more than a huge mirror. Twice the size of any existing telescope this one required a mounting of entirely new design, which cast previous experience into the discard.
- Consider the fantastic requirements: 500 tons of steel put together to tolerances as close as two one-millionths of an inch—so rigid its 75 feet of length will not deflect more than seven hundredths of an inch—so of fexible it can throw off arrhquake shock—so mobile it can be moved by the force of your breath. That is what it takes for the mounting of this telescope.
- And of the few concerns having resources of men, plant and equipment even to think of such an undertaking, the Westinghouse Plant at South Philadelphia was

given the nod-and went to work.

- If was pioneering of the highest order—practical science guiding meticulous skill in a project with six million dollars at stake. Many of the problems were utterly unique. For instance, the midday sun, beaming through skylights, could expand a 154-toa bearing enough to upset fine calculations, so a monstrous "sunbonner" had to be devised to shade the mounting during construction.
- When ready for use this mounting will provide three observation points within its structure—one will have an automatically self-leveling floor and spectrograph table, on ball bearings. A fourth observation point beneath the floor will be air conditioned and temperature-regulated.
- And this entire 500-tons of mobile structure will actually be floated on oil, requiring only 1/650,000 of a horsepower to sweep it across the skies—one flea-power.
 We make small motors, but not that small, so a one-half horsepower motor will furnish the power.
- This has been a thrilling task, even for a plant capable of turning out annually a million horspower in turbines. The inconceivable exactions of the job, the mad combination of gigantic mass with split hair precision, imposed no unusual demands, for our own products regularly called for just such extremes of size and accuracy. We feel an inward satisfaction in the knowledge that Westinghouse standards generously encompass the decimal-to-six-points accuracy required by this champion of star-gazers.

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tions. Before it ever was adopted to replace the time-tried Sprangialod 30 model, it was put through the most severe treatment that hard-hooled Army men could think of It was dropped off a cliff on rocks and hard ground It was thrown into water and left there for hours. It was rolled around a mand, kecked around in deep duck, tramped mto mud. Picked up and given no more upon than was possible with the soldner's warp and smoothness as if it had come fresh from the gun rack.

Another criticism was that it would be difficult to clean caked carbon off the front end of the root that takes the push of powder gases near the muzzle and operates the self-loading mechanism. This rod is released with no other tool than a small screwdriver, and the carbon scraped off with the same instrument.

The eights of the Garand, both front and rear, are coarser than those used in scoring world beating records with Espringfield However, it is pointed out, these sights are designed primarily for battle purposes, at 500 600 yard ranges. If fancy shooting is desired, special sights can be fitted on the target rifles. Science Series.

BOUNCING MAGNIFIER

DFSK or general utility magnifying glasses break, chip, and scratch so easily that it is strange no one has ever thought of mounting them in rubber. The Mark Specialty Company did just that and



Writes, magnifies bounces

in addition, mounted a rubber socket on one side of the rubber rim so that the magnify ing glass may be slipped on the end of a pencil. The resulting device is one that can be thrown around the desk with impunity and it will actually bounce rather than break. These small magnifiers are triple powered and come in six colors.

DRY-ICE "KEEPS" ICE

K EEPING 350 pounds of glacial ice forcen on a trip halfway across the country is something of a trick, and acentists have accomplished it by packing the ice in solid carbon dioxide (dryice). The purpose of the unusual shipment was to study are of ice crystals at different depths in the slacer. Solient News

COATING THICKNESS

TESTER

THE Ammon-Branner Magno-Cape, as Lastrument for measuring local thick ness of coatings on metals by the rapid, including the magnetic method, has been improved since its introduction in 1937. The improvement, which greatly increases the utility of the instrument, now makes possible measurement of various types and thicknesses of coatings with only one in types of magnety introchanging different types of magnety.

The instrument as now marketed will



Checking thickness of metal plate

measure nickel coatings on non-magnetic base metals, non-magnetic, metallic, or or ganic coatings on magnetic base metals, nickel coatings on iron or steel

The method is simple, rapid, non-destructive of the coating or the base metal, and is especially advantageous for both workscontrol and acceptance testing, since it permits testing of a large number of specimens at low cost.

WAGES

THE motor transportation industry is responsible for one seventh of the nation's pay envelopes

CHEMICAL PIONEER PROSPECTORS

CHEMISTS have pouned the search for oil and gas They are applying micro-themical methods to the pioneer custom of finding oil deposits be urface seepages. Unlike the pioneer prospectors, who located only shallow well by surface seepages and sometimes not even those, modern chemical expension of the pioneer prospectors, who located expenses analysis which will be an accurate guids to underlying oil deposits in any field and will locate wells at any depth

At present, they are concerned chiefly with the analysis of surface soils, or the gases contained in them, for minute amounts of various hydrocarbons and other com pounds which indicate the presence of underlying petroleum deposits Soil samples from the surface or a few feet below are taken to the laboratory There, light hydrocarbon components are driven off by vacuum distillation Such heavy components as waxes are extracted in various ways and analyzed The presence of such divergent gases as hydrogen, ethane, ethy-lene, and propane is determined Liquid hydrocarbons from surface soils, and even hydrocarbon or partly-hydrocarbon soil waxes, are being used as possible indications of underlying oil deposits

Recently, a highly sensitive device known as the "mass-speotograph," used only in the physics research laboratory for "weighing" infinitesimal atoms, has been put to work. It is used as a modern divining rod, separating and identifying the minute amounts of surface gasee which have escaped laboratory analysis.

With the "atom-weigher," it is possible

With the "atom-weigher," it is possible to run a qualitative and quantitative analysis on an unknown mixture of hydrocarbon



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gases smaller in volume than the head of a pin. Results of the analysis may be obtained in 10 minutes or less, scientists say. Another device, newly-developed to aid discovery of new production horisons in already-developed fields, contains a very sensitive electric eye which responds to emissions of Gamma rays from geological structures. Lowered to the bottom of the well and raised slowly, the "eye" registers variations in the Gamma rays given off by each strata, which are recorded automate cally at the surface

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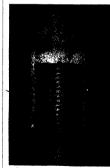
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PREVENTING WATER HAMMER IN PIPES

MANY householders have found to then annovance that a serious hammering occurs in the pipes every time a faucet is closed. This hammering sometimes causes breaks at pipe connections. Such breaks may not be important in homes but are very serious in industrial plants. The ham mering is caused by the great increase in the pressure within pipes when the flow is suddenly stopped by closing the faucet That pressure may run to as high as 600 pounds per square inch if, for example,

the flow velocity is 10 feet per second.

Prevention of destructive water hammer may be accomplished by the use of relief valves and air chambers. Some householders simply mount a five or six-foot length of pipe vertically and close it at the



Cross-section of the bellows device that prevents water hammer



Back-pressure in water pipes is absorbed by compressible bellows

top to hold a column of air in the water main in the basement. However, there is difficulty in keeping the air in the chamber. Positive and permanent relief is obas the Wacor Water Hammer Arrester This consists of a closed metal bellows or com pression compartment which is filled with a special compressible emulsion and is mounted in a casing connected to the piping system With this there is no need for maintaining air in the chamber, for the back pressure is cushioned by the compres aible bellows. The arresters are made in different sizes having bellows of different volumes

When a Wacor Water Hammer Arrester is put on the line, the sealed compression chamber is partially compressed as the water pressure is turned into the system. When a valve or faucet is opened, the bellows expands, but when the valve or faucet is then closed the bellows acts as a spring to take up the shock by compression The manufacturer claims these devices have been subjected to as many as a million shocks without rupture

REFILES

J APANESE beetles this year will be attracted by traps painted yellow, as that color has been proved to attract more of these beetles than any other color.

EATING GLASS

OR generations laymen have believed that glass, if taken into the food tract in either powdered or chipped form, would be invariably fatal. This belief seems a little too broad in its scope, according to m article in the Journal of the American dical Association which recently answeted a query on this subject as follows:

The ingestion of glass may or may not be fatal. The nature and extent of the harm done, if any, depends on the size, skape, and number of particles ingested

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and on the presence or absence of food in the mouth with the glass or in the gastrointestinal tract at the time the glass is swallowed. The danger has in perforation of the wall of the stomach or the intestine and in acute or subacute gastro-enteritis. It would hardly be safe to say that the average person can chew up and swallow glass without suffering immediate injury, but it seems to be beyond question that some

Pounded Glass and Other Mechanical Irri-tants, in Legal Medicine and Toxicology') reported a case in which 'a professional glass eater,' in the presence of Dr Haines and of Dr. E F. Ingals, ate half a dozen six inch test tubes, two good sized lamp chimneys, an ordinary four-ounce medicine bottle, two pieces of window glass, each four inches square, and three slips of colored glass each one inch wide and three inches long, biting the glass off the pieces offered him, chewing it up, and swallowing it much as if it had been an ordinary article of food. The glass eater had eaten a hearty meal before submitting to the test, as was his custom before each exhibition He was kept under observation for several hours after eating the articles named, but at no time did he show any unfavorable symptoms. He died, however, two or three years later, from a subacute gastro-enteritis, presumably. Dr Haines save, from the irritation produced by his long continued glass cating There are other well authenticated reports of similar purport'

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handling in the field is required to protect the lining, except that the pipe cannot be deformed. The pipe can be shipped, cut to length, and fitted just as unlined pipe-the lining being able to withstand without chinping any blow on the exterior of the pipe which does not actually dent the pine

CUTTING-OFF MACHINE

A NEW machine of the bonded-abrasive A wheel type is announced by the American Instrument Company, for cutting glass, quartz, ceramics, metals, commercial



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OPERATIONS TO CORRECT DEFORMITIES OF INFANTILE PARALYSIS REPORTED

OPERATIONS in which muscles are transplanted, bones reshaped, and joints fused together to help infantile pa ralysis patients recover from the deformities and handicaps left by the disease were reported by Dr. Henry G Hill, of Memphis at a recent meeting of the Southern Medical Association.

One little girl whose case he described can now stand erect and walk fairly well since operations on both hips, both thighs, both knees, and both feet.

Operations should not be undertaken for at least two years after the attack of infantile paralysis, Dr Hill warned. If the cells of the spinal cord have been damaged but not killed by the infection, they will



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eventually return to normal and resume their function of supplying the muscles with nerve stimuli or messages for actio and the paralysis will disappear, provided the patient has received proper treatment during these early stages. This improvement may take two or more years, however Consequently, the surgeon should wait at least that long before operating to correct or minimize deformities

Muscle transplantation is suited to patients who have received proper treatment early in the disease By this operation, the strong group of muscles may be divided and enough of them transferred or transplanted to the opposite side of the joint to restore muscle balance, so the muscular pull is not all in one direction, which in itself may produce deformity - Science Seruce

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UNIQUE FOUNDRY

THE success of Ford Motor Company metallurgists in developing cast-steel automobile and tractor parts as strong or stronger than the forgings they replace has led to the construction of a big new steel foundry unit in the Ford Rouge plant

Steel is poured continuously in the new unit, the molds being brought on a conveyor to the pouring spout of the electric holding furnace. Formerly it was necessary to pour intermittently because the steel was melted a few tons at a time in individual furnaces In addition to saving time, the new Ford method produces more uniform castings by delivering the metal for each casting at uniform heat and composition

The steel foundry is carefully synchronzed It includes melting furnaces, steel holding furnace, core-molding machines, conveyors, heat-treat and annealing furnaces, and cleaning room Parts such as plow beams, tractor front axles, tractor radius rods, and wheel flanges can be made in sufficient quantity for 250 tractors a day. This involves pouring from 90 to 112 tons of metal a day. A smaller foundry unit constructed nearby will produce a variety of small steel parts in comparable volume.

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of the many desirable features of wood pavements and in an attempt to use large quantities of low grade and under-sized timber unsuitable for ordinary commercial purposes, the Deidesheimer method has been natented in most European countries and is called "wood-stone" paving. As the name implies, it consists of both wood and

On a previously prepared macadam base. either treated or untreated, the wood is placed in the form of cylindrical blocks. four to ten inches in height, which are cut from saplings or other undersized timber. preferably hardwood, with a diameter of from two to five inches. The blocks are cut to the requisite length at the site, barked, and then impregnated, immediately prior to laying, in a vat of Wolman salts These treated cylinders are then placed on the prepared base in an upright position and tamped or rolled Stone chips are then used to fill the gaps between blocks, subsequent rolling and watering forcing the into the wood, keying the surface together This surface may be treated with an asphalt emulsion, which further fills the yords be tween the blocks, and a sprinkling of fine stone chips which are rolled into the exposed tops of the cylinders, forming a waterproof and durable surface The preparation of the base would be governed by the character of the traffic to be carried by the completed road - N V Felsovanyi, in American Forests

Who Was Shakespeare?

(Continued from page 264)

26th, The San Francisco Argonaut carried an editorial entitled 'Who Was Shake speare?", paying high tribute to the import ance of the X ray and infra red evidence

Newspapers in France, Switzerland and Holland have also played up the story Charles Boissevain, a well known journalist of Geneva, is translating the complete

Scientific American article into Dutch for publication in the Lowlands Letters received by us from readers fell

into three classes Those whose writers objected to doubt being cast upon the identity of the "officially approved" Bard of Avon, those whose writers demanded more proof of Lord Oxford's identity before drawing any conclusions, and those - evidently already possessing some acquaintance with subsidiary evidence connecting Oxford with the Shakespearean authorship - whose writers greeted the publication of the X-ray and infra-red investigation as an event, charged with important historical and biographical implications We quote a paragraph from one of these latter, written by Fred H. Colvin. editorial veteran of the McGraw-Hill Publishing Company:

"The disclosures made by modern photo graphic methods show clearly that the old paintings had been altered. The resem-blance of the faces and features, as shown, together with the careful study of the hands. ring and wild boar device, should convince the most skeptical. It has long been a

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mystery to me why so many cling with a sort of blind loyalty to the idea that an illiterate butcher boy could have written of life and places of which he could have known nothing whatever'

One of the very last letters written and signed by the late Lord Tweedsmuir, the scholarly Governor General of Canada, expresses his thanks to a friend for sending him a copy of the January Scientific American. As a historian and writer of mystery stories, Lord Tweedsmuir (John Buchan) appreciated the evidence disclosed by the dissection of the Ashbourne painting "I have read the article by Mr Barrell

with very great interest Will you convey to him my thanks?

. Yours ever,

TWEEDSMUIR" For the benefit of readers of the January issue who demanded more evidence, we publish on page 264 an X-ray photograph of the Ashbourne portrait which was crowded out of the original article

This shows that underneath the re arranged hair which "Shakespeare" wears in his Ashbourne picture is the same type of large ear with the wide anterior open ing that very peculiarly characterizes Lord

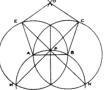
Oxford in both of his inscribed portraits. We would also reiterate that the evidence of the three disguised Shakespeare portraits which connects them with Oxford's personality in so many ways cannot be logically attributed to commercial art fakers who "accidentally" got hold of the portraits at various times and fixed them up to palm off on gullible Shakespearean enthusiasts

The discusses that have been applied to the original Oxford paintings bear so close a similarity, and are of such ancient an plication in the opinion of competent experts, that it is apparent that the work was done at a time when all three pictures were available to a small group, such as the original family owning them. There is no record of any of these pictures, on the other hand, having been bandled around among unscrupulous art dealers Each of them has an "heirloom." rather than an auction room. background King William IV received one as a gift from a member of the Sidney-Her bert family of Penshurst Place This ancient Kentish manor was one of the homes of Lord Oxford's son-in-law, Philip Herbert Farl of Montgomery, to whom the First Folio of the plays of "Mr William Shake speare" was dedicated in 1623

PROBLEM: THE PENTAGON

FINAL problem of the series offered our readers by Lieutenant Commander Kap lan is as follows

The accompanying sketch shows a meth of constructing a regular pentagon ABCDE Two circles are described with 4 and B



as centers and AR as their common radius A third circle MAPBN, of the same radius, is passed through A and B Through P, the point of intersection of this circle with the common chord of the first two circles, lines are drawn from M and N which cut the original circles at E and C. With these latter points as centers, and the same radius as that of the three circles, arcs are swung which intersect at D, the final point of the construction Show whether the method is exact, and if not, determine the error of approximation by evaluating the angles at the five vertices of the pentagon

SOLUTION OF THE SECOND CIRCULAR PASTURE PROBLEM

AST month's problem read as follows A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200 feet long to a point on the fence, and outside the enclosure. Over what area will the cow be able to graze?

In a private communication to the Editor.

Commander Kaplan had said "In spite of the brevity of the solution, this is not an easy problem The integration is rather differently accomplished than ordinarily The usual method of approach would lead to a much longer solution " "# hs didn! the Editor tell us this fact last month, when it would have done some real good?", many a reader is going to say to this Well, isn't mathematics like that ' Did the professors ever give the poor victims advance tips in examinations? Ours didn't This is a cruel world without a doubt

The solution

The cow will be able to graze over a semi circle of radius 2r, and the two equal areas which he between the circular field and the curve traced out by the free end



of the rope as it winds around the fence The element of area for the latter may be taken as the triangle shown in the accompanying sketch, and the area of each loop

will be expressed by the integral,
$$\frac{r^2}{2} \int_0^1 \theta^2 d\theta = \frac{4}{3} r$$

The entire area encompassed is therefore

area encompassed is
$$2\pi r^2 + \frac{8}{3}r^2$$

and, since r in the problem given is 100 feet, this evaluates to

$$20,000\left(\pi + \frac{4}{3}\right) = 89,498.52 \text{ eq. ft.}$$

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly denartment presenting a wide variety of discussion regarding frearms, their handling, and their accessories Suggestions from readers will be heartily welcomed -The Editor

THE TEST OF TIME

W/HEN Theodore Roosevelt said, The old days were great because the men who lived in them had mighty qualities, he could have added that the doughty in dividuals referred to injected into many of their actions and some of the products of their hands a goodly portion of those same "mighty qualities." Take frearms, for example Samuel Colt introduced his famous Single Action 6-shooter, 45 caliber "Peace maker" in 1872, and followed with the equally well known and similar 'Frontier' model in 44 and .44 to calibers, a gun which has changed but little during the past 68 years. John M. Marlin perfected his repeating, lever-action rifle in 1880 and 10 years later applied the principle to a solid top, side ejection 22 caliber rim fire rifle, known then as Model 1891 and today as Model 39 A. These are but two instances of those "mighty qualities" of which "led dy" Roosevelt spoke, instances in which men of earlier days so nearly attained per fection in gun craftsmanship that artisans who followed their footsteps have been up able to improve the basic features of these two breezes

Although refined by later day expertand engineers, the Colt Single Action Arms Revolver of today is still fitted with the original "Peacemaker' type of hammer, trigger, action, and rod ejection mechanism initiated by Samuel (olt 68 years ago. Aof old, the gun is available with barrels of 434, 512, and 712 inches, and the weight has varied little. The splendidly told, profusely illustrated story of Colt arms, Century of Achievement," depicts both guns and as my buseen from the nicture



Easy to clean

in that book, the similarity of lines and details is striking Save for the grip and the front sight, the 1873 "Peacemaker its 1940 counterpart are practically twins

John Marlin made gun history and creaicd a sensation when he brought out his 22 caliber, lever-action repeater in 1891 Not the least among the original features still found in the same gun, 49 years later. are the deep-cut Ballard rifling, noted for accuracy, and the ease with which all working parts may be exposed for cleaning and oiling by the turning of a single screw. This was accomplished by making the cover plate a part of the stock, thus separating the receiver into two halves. That portion of the receiver to which the barrel is attached carries the breech bolt and the ejector The other half of the receiver, to which the stock is fastened, houses the finger lever, hammer, trigger, cartridge carrier, and other working parts, all of which are securely attached and impossible to lose when the tifle is apart or in take down condition. In addition, the 39 A remains, as at the time of its inception, the only lever action, 22 repeater manufactured

We've no intention of belittling the exploits of pioneers in other fields, but it does seem worths of note that in few products have their been less basic changes during



Retaining the best features

the past half century. With everything be ing "streamlined" and brought "up to the minute' these days, it's gratifying to know that in the realms of handguns and rifles at least certain basic principles have so successfully withstood the multiple tests of time, world wide distribution, and varied usage that it has been difficult to improve on them Continued universal acceptance of the underlying methods of operation of Samuel Colt's "Peacemaker" and John Mar bin's lever-action is a tribute, indeed, to

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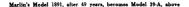


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By Charles Edward Chapel

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those who today direct the policies of their respective houses by carrying on the sound tenets of firearms manufacture originated many decades ago by Messrs. Colt and Marlin

Mossberg's Triplets

Thas long been more or less an axion in firearms circles that when O. F Mossberg & Sons, Inc., announces some thing new in rifles, the .22 caliber section of the gun world sits up to take prompt notice. The heralding of the three latest Mossbergs, Models 42M, 46M and 51M, has proved no exception to this rule. In the order named they are a 7-shot clip re peater, a 22-shot tubular repeater, and a 15 shot automatic, all .22 caliber, all Manlicher, Mauser, or Military type - which ever name you prefer - and all rugged and built for dependability and accuracy Each member of this new family of "M's is equipped with hooded ramp front sight with four permanently attached inserts. No 2A rear eight with screw adjustment for windage and elevation. No 4 microclick peep sight which swings out of the way. permitting use of open or scope sights.
They all have detachable swivels, non breakable molded trigger guard with finger grooves, and in the cases of Models 42M and 46M, a Mauser-type bolt which hugs the stock and doesn't interfere with 'scope mountings.

If you've ever had a "Bash-back" occur while shooting, you'll appreciate Moss berg's new cover plate, which is attached to the bolt and moves over the ejection port hole when the bolt is closed, to provide additional safety for the shooter and to help keep drit and other foreign matter out of the loading port If you like a clip-type rifle, you'll find the 42M exceedingly practical, for the buttplate has a 'frap door' and the stock is cut out to permit insert too far actira clip of 7 shells. If you

as first prize in this name contest. Second and third prizes are \$50 and \$25 respectively and, again, the winners have a choice of the new guns in addition to the cash awards. We've a good supply of Mossberg catalogs and entry blanks for this contest, so let us know if you want them. There's no catch to this, nothing to buy. Be kind of mice to have a new gun this season, wouldn't at?

FROM THE MAIL BOX

TOLLOWING publication of the story, "Shotgan Herey" in the January issue, we received a number of reader in quires requesting more information on the one-power (no magnification) short waves to pany, for use in trap, skeet, and wing shooting Now comes a note from "Bill" Weaver enclosing copy of a letter from T. Lee, The Short Sh



The Weaver shotgun 'scope and



how you sight with it

lina quail hunt with the Weaver 1-X 'scope on a 12 gage Winchester pump scattergun, and who writes "I don't recall missing a shot that was in the open or where the bird was in sight"

Claiming equal success in dove and crow shooting, Lee also spoke of breaking 49 birds in skeet, "heavily dusting the lost bird," while at the 16-yard traps he won a turkey shoot with another 49 But the ex treme versatility of this Weaver 'scope, and, incidentally, of Lee's marksmanship, too, is shown in the following quotation from Lee's letter. "Past Saturday we varied our rifle program a little and did a good deal of shooting at aerial stuff with the .22 and this 'scope For lack of something better, we used black walnuts, which measure 1 to 11/2 inches when hulled and are a pretty stiff target for this stuff, when pitched about 20 feet high. I had one run of 24 straight, taking all shots, whether good tosses or not. I find it very definitely easier than with peep sights or open sights and no trouble to put in repeat shots. Mine is mounted on a Remington pump 22, but if I had it on an automatic, I could put in three to four shots easily

All of which bears out Weaver's own claim that "the 1-X 'scope is unbeatable for many kinds of rife hunting, especially large game and moving game, for fast shots and in wooded country. For rifle," Bill



No flashbacks with the new Mossberg bolt-action .22 rifle A plate covers ejection port when bolt closes

Right In the same gun as shown above, an extra clip is carried in the stock

dislike loading, you'll like the capacity of the Model 46M

On the other hand, if you're of the automatic school of firing, the 51M fills the bill and handles. 22 regular or high-speed long rifle cartridges, either lubricated or dry, without any change, and you can pack 15 of them into the magazine

The Mossbergs prefer that the shooters of America christen this new family of "M" models, so this is a case of "Name it and you can have it." There'll be a check for \$100 and choice of any of the 3 models

continues, "a flat top aiming post is used instead of the large, coarse center dot designed for shotgams." We have on hand a supply of Weaver's folders, describing and picturing his 'scope, and you're more than welcome to one, if you'll just drop us a line.

PITTMAN-ROBERTSON

Act

OF importance to all who buy guns and ammunition was the recent address by Albert M. Day, Chief of the Division of Federal Aid in Wildlife Restoration, Bureau of Biological Survey, to the North American Wildlife Conference in Washington From the 10 percent excise tax on sport ing arms and ammunition, Federal appropriations have been made to states which have given specific legislative assent to Pittman-Robertson Act provisions, the Federal Gov ernment bearing 75 percent and the respective states 25 percent of the cost of these undertakings Some fine work has been as complished, such as taking submarginal lands out of agricultural production in 15 states to provide badly needed range for deer, elk, moose, and bighorns, and food, cover and sanctuary for grouse, turkeys, pheasants, quail, Hungarian partridge, ruffed grouse, sharptails, rabbits, and other species of birds and animals. Projects for purchase of areas to restore conditions for waterfowl and fur bearers are being considered in six other states. Re-vegetation of lakes and water courses, re-seeding of burntover areas, reallocation of game populations, and research laboratory work are among other activities, all tending to improve the nation's wildlife resources Summing up. Day said "If the game departments confine their activities to those of the caliber undertaken during these early stages. Pittman-Robertson will, in truth become, as its sponsors predicted, the greatest boon to wildlife conservation since the passage of the Migratory Bird Treaty Act ın 1918."

Pot-Shots

AT THINGS NEW

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SMITH & WESSON presents to the handgun fraternity their new S & W "K-22 Masterpiece" as a worthy successor to the famous S & W. "K-22 Target Revolver" Incorporating a 6-inch, precision drilled, reamed and rifled barrel on the frame of the veteran 38 M. & P. target gun, with an over-all length of 11-1/8 inches and a weight of 35 ounces, the Smith & Wesson folks have produced a .22 caliber handgun which embodies even greater speed, accuracy, and ease of handling than the world-known "K-22." The cylinder, with recessed head space, is chambered for the .22 L.R. cartridge, as well as any other rim fire .22. New developments which command attention are the S. & W. micrometer rear sight, which provides positive two-point elick adjustments for windage and elevation—and these adjustments will not aboot loose, the "Speed Lock" hammer, which offers shorter, faster, caser cocking, and allows grip to remain unchanged during fast fire All mail, this "K2 ZMasterpace" is a "he-mania" gun, made "with the rogged precision of a Freinch 75," to quote CV, Bassett, of S. & W. Want a folder? We have some.

AMERICAN OPTICAL COMPANY has developed a synthetic sponge sweatband for elimination of the hot-weather perspiration problem, faced by all target-shooting devotees. It is adjustable to any head size by an elastic band, may be worn with or without a hat; is washable.

HARRINGTON & RICHARDSON ARMS CO. has introduced a new six shot target revolver. known as "Eureka" model It weighs 30 ounces, has six-inch barrel with sights adjustable through large-headed screws, and choice of 11 different sizes and styles of grips, with standard equipment No thumb rest type. Gun has leaning rear sight to remove possibility of shadow serve the set pull in pounds and to offer smoother, sharper action, trigger pull is adjusted by means of rounded edges, rather than sharp edge hammer notch latch is on left side for easier handling, thimble and extractor are heavier, lifting ratchet has two points, all tending to increase wearing qualities

Wz'vr. A Birsett that most gon owners are also the possessors of fishing rods of one kind or another, so we just have to mention three splendid angling publications which, to us, are The Books of the Monciel. They are, "No Life So Happy," by Edsin Lewis Peterson, "Fur, Feathers, and Steel," by Reuber R Cross; "The Fly Trer's Handbook," by H G Tapply, H you fish, you'll like 'em dil, if you tey your own brees, the latter two should be on your "must" het.

GLAS RAG PRODUCTS CORP offers a polabiing cloth, approved by Good Housekeep ing lenking the sufficient unto intell' untitude past, powder, or polish. In either 10 or 20 cent size "Glad Rag" performs hightening miracles on all metal aporting equipment with a minimum of "ellow grasse" — works equilibly well on silver, too, so if you don't find it in our sports cabinet, look in the kitchen our

NEW METHOD Mrc. Co. has a product, "New Method Gun Bluer," which immunizes guns against exterior rust, corrosion, and dampness, is easily applied with a camel's hair brush, and restores highly polished blue finish: "New Method" is not a "chemical" cleaner, but is a hard, perfectly colored lecourer.

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Docs

DOGS are wonderful playmates but ex Dasperating camera subjects Par who appear to be on the go every minute of their lives. Dogs are best photographed when they show the appearance of being on the alert. On the surface this would seem to be easy to do but in practice it will be found one of the most difficult of all photographic "assignments" dilemma facing the photographer of dogs is that, although most characteristically pictured when 'busy,' the dogs will gen erally be sufficiently quiet for leisurely photographic work only when at rest.

Needless to say, photographing dogs calls for an alertness on the part of the camera



"Lookout"



"Siesta"



"Pater

worker perhaps greater than that of the subject itself. At the same time that he attempts to keep the dog interested in one thing or another, the photographer must also think of the picture. This means that he must watch patiently for a good pose and he quick enough to conture it with his camera. As the dog moves about, ready to dart this way or that at a moment's notice, the photographer must follow the dog's lead and move the camera viewpoint in unison with the unpredictable movements of the dog

However, in spite of the obstacles, many good dog pictures are made and some of the best are the work of amateurs. It is chiefly a matter of watchful waiting for a good pose plus ample lighting condi-DOSIITE

As for lighting undoubtedly the outdoors on a bright day is the ideal because there is so much light about that the dog can move in perfect freedom (as it will anyway) and still be suitably lighted in one pose or another Indoors, the dog's move ments are greatly restricted, photographi cally speaking, because only a small area is lighted and unless the dog remains within that area, it will not be illuminated and therefore cannot be photographed. How ever, there is a logical solution to this problem in the use of the synchronized flash Since the lighting source, attached to the camera, moves with the camera, and is "flashed" in the same instant as the shutter is opened, the subject is bound to be lighted during the only period you care about the moment of exposure.

Ample lighting is important in dog as well as general animal photography. because one of the most valuable features of dog pictures is the manner in which the texture of the subject shows up. For this reason, also, full expoure is necessary in order to take advantage of all the warliable lighting. At the same time, the worker must be sure to use a shutter speed price order to stop the movement of the dogs on that the subject is sharp on the resulting negative. It is true that a futile off-sharpness in the top the worker must be supported by the subject of the subject in the subject is sharp on the more subject to the subject in the subject is sharp on the negative subject in the subject is sharp on the subject in the subject is sharp on the subject in the subject is sharp on the subject is sharp on the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the subject in the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the subject in the subject is sharped in the subject in the su

Perhaps it is safe to say that picture of dogs in movement should not be taken of dogs in movement should not be taken at shutter speeds slower than 1/100th of a second. Many inexpenses canners air equipped with shutters having this as upspeed. Those which do not would best be restricted to dog poses which show only moderate movement, or those instances when they are well pictured in quiet, restful activities.

When you photograph a dog or any other aubject you must not forget that you also include the background in you preture A poor background - one, for example, in which there is such distracting material as telephone poles, pecket fences, and so on — may spoil an otherwise fine preture. Therefore, select a suitable background and try to induce the dog to move in that area. The greaves this area, the restricted, for one reason or another, your work becomes more difficult.

In this connection, we cite an experience in photographing an Irish setter against a background of trees. Particularly were we interested in two of the trees, one to the left of the foreground, the other, curve shaped, farther back. We wanted to get the dog to pose between these two We were not quite sure just what pose we wanted, and did not bother too much about this because we felt that any agreeable pose would be suitable provided the dog stonned somewhere between the two trees and near the large straight one in the foreground Luckily there was a hearh nearly where we could sit and patiently wait for the picture. We threw an apple where we thought it would do the most good but Patsy simply snatched it up and ran off quick as a flash. We tried it again and again with somewhat the same result Every once in a while Patey would stop to



By Edward A. Schults, from the Fourth International Leica Ethibit



"Silbonette"

rest but too far off for our purpose's Finally, she stopped for an instant in the foreground, attracted by something off to the left and as she did so we snapped quickly and so obtained the only usable negative. The procedure took about an hour but the result is one of our favortes. Pats, an ardent lover of the woodlands, pictured in an at mospher, most congenial to her nature.

AUTOMATIC CONTROL IN THE DARKBOOM

A DEVICE that takes one more worry off the shoulders of the darkroom worker and assists in doing better work with the enlarger is the new Bee Bee Dual Control Auto Timer, just introduced The two



streams of this device make it possible to time of the self-glith while switching on the printing light or to reverse this procedure at the termination of focusing of exposure time. When the darkroom worker touches a logic switch, the exposure is started and is terminated automatically at exactly the issue, it is possible to repeal exposures of exact duration, the mechanism reserts itself without further attention.

Operation of the Dual Timer is accomplished by the use of a self-starting synchronous motor. The whole device weighs only five pounds and measures 434 by 43/2 by 53/2 inches.

"PHOTOSPOT NEWS"

A MONTHLY hulletin addressed to camera clubs has been inaugurated by Raygam Corporation, New York City, for the purpose of acquaining club members with "the latest in photographic news,



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views and previews" It will be edited by Albert Greenfield, photographer, traveler, and a well known figure in photographic circles Primarily designed as a news bulletin, it will contain description and illustrations of new photographic equipment as well as other news and notes of interest to amateur and advanced photographers Camera clubs interested in receiving this bulletin should write to Photospot News,

SHOOTING ALLEYS

AN alley is a short, very narrow atreet or passageway People actually live in alleys Remember Henry Carey's Sally "Of all the girls that are so smart

There's none like pretty Sally; She is the darling of my heart,

And she lives in our alley Clarence Tolle, of Cincinnati, Ohio, does not live in an alley but alleys seem to fascinate him. His town is full of them, and



"City Alleyway"

he likes nothing better when out with his camera than to make a round of the alleys and take pictures of them under various lighting conditions. As a result, he has a considerable collection of alley pictures taken in his city, one of these is reproduced here. He doesn't care what other people may think, but an alley to him is No. 1 on the list of picture possibilities in his town

BEST SCHOOL PICTURE

THE accompanying reproduction, "A Very Good Boy," photographed by Am-brose J. Hickey, staff photographer of New York City's Board of Education, was chosen in a poll of New York City's 37,000 school teachers The vote was taken to select the best pictures that have appeared in Super-intendent of Schools Harold G Campbell's annual report called, "All the Children. It received a total vote of 5062, two and a half times as many as that received by its nearest competitor Second place was given to a picture entitled "The Youngest given to a picture entitied and including and Artist," which showed a kindergarier boy at work before an easel; third place to "Boy Building Blocks"; and fourth place to a picture entitled, "Charge d'Affaires Bag," which showed a little boy trudging to school with a brief case almost helf as

BOOKS 1 BOOKS

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Amateur Photographers

New WAYS IN PHOTOGRAPHY, by Jacob Deschin. Eminently practical book centians nothing of theory and nothing that the advanced amateur photographer, will not find valuable in one way or another. It covers the value range of ameteur photography, whole range of ameteur photography tography, photomurals, retouching, infrared, and an umber of other subdivisions that will not be found elsewhere in a select and concrise a man-

So You Want to Take Better Pictures, by A. P. Peck A friendly, faceto-face chat with the camera owner who has his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to utilize it to best advantage. Over 200 pages, dozens of illustrations, \$210.

UNIVERSAL PHOTO ALMANAC AND MARKET GLIDE. How, when and what to photograph in order to make money with your camera, where to sell different types of prints \$1.00.

AMATEUR FILM MAKING, by George H. Sewell, A R.P.S. Useful to the beginner as well as the expert move maker. Tells about films, cameras, exposure, film editing, story telling with the camera, and so on. Illustrated, 31.60.

CHAMPIIN ON FINE GRAIN, by Harry Champlin. A complete hand-book on the entire subject of fine grain, including formulas and how to compound and use them. \$1.85.

PHOTOGRAPHIC HINTS AND GADGETS, by Fraprie and Jordan How to make all kinds of photographic accessories, from film clips to cameras to lighting equipment, and so on; 250 articles and nearly 500 illustrations, \$3.60.

PORTRAIT PHOTOGRAPHY, by H. H dliams. Fundamental principles of composition and lighting, paving the way to satisfactory results in this particular branch of photography. \$4.45.

PHOTOGRAPHIC ENLARGING, by Franklin I. Jordan, F. R. P. S. One of the most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salonwinners, show the value of correct technique. \$3.50.

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ROOKS ROOKS



"A Very Good Boy"

hig as he is, but containing only one book Dr. Campbell, in commenting on the first choice of the teachers, and that its popularity was due to its human appeal and to the fact that it was typical. "It might have been taken at almost any school, anywhere in the country, at any time," he said

DEVELOPMENT BY

INSPECTION

THE often desirable method of develop-ing films by inspection may be practiced with the slower brands of film by comparing the developing film with a stand ard negative However, unless this guide negative is unfixed, it will not do for this purpose The unfixed-out salts must re main in the guide negative in order that it may match the developing film which, even with development complete, looks denser than the final, fixed negative will be To obtain the arrested development which normally is done by fixing in a hypo bath, the comparison negative, according to a tip in the Genaert Sensitizer, is developed, washed for a short time, and then bathed for a short while in a 2 percent potassium iodide solution

ACID-RESISTING ENAMEL

Took the chap who is making his own wooden darknoom make or table, we have recently come across a preparation that seems to serve the purpose with full protection against damage. The material is known as Tutolo No 274 Ennate and is especially adapted for use on articles connected with photographic work and developing. We asked the manufacturers for details and this is their report:

"This is an acid-cessing coating made from Bakelite resin, which will protect all darkroom equipment from hypo, developers, acids, and so on, and when used on trays or racks will keep solutions free from contamination. It can be applied to wood or metal solution tanks, reels, table tops, and so forth

"The material is applied by brush just as it comes from the can, and will set in about 15 minutes and dry in one hour However, at least eight hours should be allowed before strong solutions come in contact with it. One cost is usually sufficient to cover any surface, but if a second



ATISFIED with the quality of your pregative and print? Honesely now, how many of your prints would "rate" in alson exhibit? You will find in Lafeyette Duraluminum Filter Mounts end Optical Glass Filters a quick, reliable and thirty way to improve your prints, enabling you to capture all the fine degrees of tone, attaining such preture you take—Salon material. Check these for value, too—and remember, you'll find many more great values where they came from—the new Lafeyette Camera Catalog.

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coat is necessary, it would be best to allow eight hours for drying before the second

coat is applied "The only precaution necessary in ap plying the material is that the surface be smooth and dry and free from dirt, wax or oil, so that the enamel has a good op portunity to make a strong bond with the If a surface is only or has been waxed, then it should be cleaned by wiping with plenty of turpentine, wiping off the excess with a dry cloth Rough or rusted surfaces should be smoothed with sand paper before an application is made. This material comes in aluminum, black, grav or clear

TEMPORARY LENS BOARD

CCASIONALLY you may wish to try out a friend's lens on your camera or to experiment with a lens before deciding to make the actual purchase. This is provided, of course, that your camera permitof interchanging lens boards. To go to the expense of making a special lens board is out of the question. An effective temporary lens board may be made of a thick mece of cardboard cut to the required dimensions In the center of the board a hole is cut the diameter of which is slightly smaller than that of the lens barrel Now "screw the lens barrel threads into the cardboard The barrel threads will out threads into the cardboard and so hold the lens firmly in place while you put it through its

HISTORY IN PHOTOGRAPHS

THE formation of a Contemporary Hisseminate photographic information that will be of aid to historians,' is announced by plan is to work through existing agencies and coordinate the activities of those now engaged in this field rather than to set up a separate organization. The committee's first chairman is Dr A J Olmsted, Chief Photographer and Custodian of the Section of Photography of the Smithsonian Institu tion and the U S National Museum of Washington, D C.

One of the most interesting sections of the Division will be that devoted to stereo scopic slides and cameras, this phase to be under the direction of Robert Dennis, of Brooklyn, New York, reputed to be the owner of the world's largest collection of slides, a total of more than 100,000, and old stereoscopes

The Photographic Society of America has also instituted an interchange of stereo scopic slides for individuals. "Each participant. acording to the announcement. 'will add a slide to the group that is sent for his inspection before sending it on to the next individual. When the collection returns to him at the end of a couple of months, he will remove his old slide and substitute a new one. There is evidence that there are more users of stereoscopic devices in this country than anyone would believe and the Society feels that such a service would fill a definite need

Another plan being worked out by the chrome slides. The plan is to have two sections, one for clubs and one for indi-viduals. The first will work along the same lines as the present Club Print Interchange

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Anyone wishing to participate in such a service should communicate with the Secretary of the Photographic Society of America 10 Park Avenue, New York, New York

CLOUDS SAVE THE DAY

THE presence of clouds is always a good excuse for a picture, and subjects which ordinarily hold no promise can frequently be worked in very nicely when shot against



"The Barn"

the background of an attractive cloud effect. A barn of itself may or may not offer a picture possibility, but in combination with clouds against a dark field of sky obtained with an orange filter, it may well justify a shot, as in the present case Angle composition seemed to tre the picture into one position seemed to tre the picture into one

LEICA MANUAL 1940-41

COMPLETELY revued to include the latest information on minature camera photography, a new prating of the "Less and Manual," designated as the 1940-4 edition, has just been assued: A new filter factor table as included, filing groupings have been changed to coincide with recent advances in films for minature cameras, and new in possess, projection, stereo projection, lenses, Lerica accessories, and so on.

Don't Argue With The Instruction Book

44 AFTER all," says the concluding sen tence in the foreword to an instruction booklet for one of the Filmo cameras, "we made the camera, so first try our way of using it? There's a lot of common sense back of that, obvious though it may appear to be. Over-confidence and eagerness to

get going with the new outht frequently induces people of newly purchased cameras to use the camera before they have read the instructions. The consequence too often is that something jams because some little gadget was not properly adjusted, although reference to a single line in the instructions would have avoided the accident.

"We have had a good many comments on that sentence, all of them flavorable," say Bell 8 Howell, the makers of the Filmomeras. "Before the hook went to press, we tred out the statement on several distinction of the statement of the statement on several distinction of the statement of the statement was 100 percent favorable, we dared to indicate the statement of the statement of

Personally, we believe that one of the principal reasons people do not read in struction books as thoroughly as they should be because they are not always as clear in their explanations as they should be. Also the size and appearance of the type and general layout is not attractive enough. Our the institution book as good-looking a your advertising hierature, and it will be read.

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time and choosing correct contrast grade of enlarging paper Scale is four-inch disk divided into 10 numbered sections which decrease clockwise in density Test print is given 60-second exposure, with scale placed on top of sensitized paper in paper holder After print is developed, correct exposure time, in seconds, can be read directly from best sector, as printed

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(\$20) Employs photometric principle. May be used under wide variety of light conditions Does not require approaching the subject but is employed from the position of the camera. Also adaptable for use as an enlarging exposure meter "Miracle Eye" feature gives average reading of enure scene, whether near or far from camera. Maker's claim is that the "Miracle Eve makes is possible to measure light on any detail of a scene, to obtain reading on object unfalsified by stray light, background, and reflections, to measure an area of light as small and as dum as flame of a candle 100 feet away.

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LAFAYETTE DURALUMIN COMBINATION TABLE-TOP TRIPOD. For use with min-nature cameras of all types. Weighs only 8 ounces complete, but said to be capable of providing support for weight of about 100 pounds. Three rubber tipped duralumin legs screw into supporting collar, which contains "extension neck" permitting adjustment of camers on tripod from heights of 11 inches to 17 inches. Neck completely removable from supporting collar May full leather strap attached to bottom o

UTILITY CUTTER (Handle and one blade, \$1.00; extra blades, 60 cents per dozen) Adjustable device for holding cutter blades in proper position. Metal frame fits hand. uses heavy-weight blades that slide into handle when not being used. Cuts cardboard of various weights, heavy wallboard, or light veneer wood Polished aluminum handle with wing locknut

CHARDELLE FLASH CALCULATOR (50 cents) Rotating device fitting pocket for de termining shutter speed and 1/ stop for various flash bulb sizes at different dis tances Disk carrying row of shutter speeds and row of distances, the former ranging from "open" and 1 50 to 1/1250 of a secand and the latter from 6 feet to 68 feet. is lined up against a row of Weston film speeds ranging from 4 to 100. As disk is turned, the desired distance is set against the speed of the film being used. The #/ stops are on a separate disk, which is turned until one of four different light conditions (outdoors night, interiors very dark, interiors average, and outdoors daylight) stands opposite a number designating the bulb being used A table on the back of the calculator, which is laminated, provides a list of Weston speeds for the most popular films and a list of Chardelle illumination factors, or numbers, for the most frequently need fleeb bulbs

HAYNES "SALON" ENLARGING PAPERS Coated with a bromide emulsion which, the maker states, is literally loaded with blacks and to bring out deep shadow de tails that are often lost with other paper-The paper base itself is of pure rag stock of great strength "Salon" paper does not require special handling Dries to slightly greater contrast than when wet. Supplied in three different grades

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WABASH SUPERFLOOD REFLECTOR LAMP (\$1 10). Inside-silvered, self-reflecting, outside frosted Average burning life six hours at 115 volts. Lamp and reflector a single unit Silver lining sealed inside bulb provides brilliant reflecting surface. Oversize bulb gives oversize reflecting surface. Special silver lined neck disk redirects what would otherwise be neck-wasted light. Scientifically correct coordination of bulb, filament, and reflector.

TIMIT (\$12.50) · Combination enlarging exposure meter and automatic exposure switch. Employs test strip principle but by automatic operation. Also automatic time switch for exposing enlargements.



JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photosranhers. If an answer is desired by mail, enclose a stamped, addressed envelope Queries should be specific, but Mr Deschin cannot undersake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials -The Editor.

- Q. I am an amateur portrait photographer, but recently a friend, who owns a beauty salon, asked me to take some pictures of her hair styles for a display. Can you give me details as to lighting, camera angle, and filter? I have a good miniature view camera, tripod, and four No. 2 Photoflood lights with diffusion screens .-FC
- A Your objective is, first, to light the hair in such a way that the details of the hair dress will show up clearly, and, secondly, to adopt that angle that will present the subject to best advantage and give as complete a picture of it as you can in a single shot Therefore, you should use one front light tilted down towards the head a little. depending on the pose, and another light from the side and slightly back of the sub ject, this second light should be at an angle of about 45 degrees to the head. The best effect is achieved with spotlights. A compromise can be effected with your lights by using cardboard with a hole cut in the Your lighting should be well bal center anced because it is the complete head dress that interests you and not just a detail of Make sure that no dark "pockets" are left where light has failed to reach the hair This can be done either by manipulating the lights or altering the pose. The camera angle will naturally be somewhat above the head level Orthochromatic film is recommended for most purposes, panchromatic where the hair is very dark or very fair Filters are not necessary
- Q. 1 have a 616 Kodak Special era with f/4.5 Kodak Anastigmat lens. There are some small air bubbles in one component of this lens. Does this indicate an imperfection; will it cause any defects in the pictures?—
 H. R. E.
- A. When we answered a similar question some time ago saying that small air bubbles would have no practical effect on the image, we were "jumped" upon by a reader We are taking no chances this time and will quote from others L P. Clerc. Hon. F. R. P. S., in his "Photography, The ory and Practice". "Beginners have a tendency to consider the bubbles seen in every anastigmat as a defect. The sole effect (of these bubbles) is to diffuse about one thousandth part of the light — an absolutely negligible amount." E. J. Wall, F.

R P S, in his "Dictionary of Photography" "A lens is not necessarily bad when bubbles are present in the glass, but it is the exception for a high-class optical firm to send out a lens in which large but bles are visible, although a number of small hubbles may be present in a high class anastigmat without being any practical disadvantage" Henney and Dudley's "Hand-book of Photography" 'Bubbles in a len-

generally act merely as direct obstructions

to light and, unless of unusually serious

magnitude, are insignificant" So there

- O. We understand that there is a special type of film used for copying manuscripts Can you inform us on this subject' Also, what size camera would give best results when copying pages up to 81/2 by 11 inches? - W. L. P. A Any camera from the 35mm minis ture type up may be used for copying manuscripts, the camera lens being suit ably supplemented with tubes or close up lens or simply by extending the bellows of the camera. In the latter case, the longer the available bellows extension the more versatile it is in this regard. For the miniature cameras, positive film should be used for your purpose. In the larger size cameras, commercial or process film is weed
- O. I own a Linhof Technika, size 9 by 12cm, with a Zeiss Tessar f/4.5, 15cm lens. My problem is what lens to purchase for portraiture. Can I use a telephoto lens? Many say a telephoto will not give me the perspective of a long focal length lens, that I will have a larger image, but with distortion. Could I use a simple rapid rectilinea lens which is of 10-inch focal length? -- C. F. P.
- A The rapid rectilinear lens will do the trick very well, but of course, the slow ness of the lens, usually f/8, may be somewhat of a deterrent in portraiture, particu larly where children are concerned How ever, if the lights are strong and near enough to the subject and you employ the very fast film emulsions, this should prove no great handicap. So far as distortion is concerned. this is caused by a near viewpoint and not by the design of the lens. At a good distance from the subject, say eight feet or so, there should be no distortion in perspective with a telephoto lens.

UNIVERSAL PHOTO ALMANAC AND MARKET GUIDE 1940

AMATEUR photographers who feel that they should be able to make money with their cameres will find in this book many hints that will be of value. A series of articles tells what, when, and how to photograph, how to sell your photographs profitably, how to handle your equip-ment, what picture journalism con-sists of and how to make contacts oth editors, and many other things that the would-be photo journalist will want to know. A pictorial section presents some of the work of this ountry's foremost photographers; a large formulary gives in compact form most of the standard formulas. The market guide section tells who purchases what kind of photographs. approximately the price paid, and gives other pertinent data regarding hundreds of publications that are in the market for photographs.

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By Julian Ellis Mack and Miles I Martin

DESIGNED as a text book for college use, the thoroughness and systematic treatment that has gone into the prepara tion of this book will be appreciated as well by the general reader with a genume cuntuck. In the words of the authors, the book is "not intended to be either a handlook of practical methods or an exhaustive reference work," but "is concerned chiefly with the principles and basic techniques of the process." 1506 pages, 736 by 1036 inches, 15 lufungs photographic exproductions, mutually and the principles of the process in the proposition of the process of the process of the proposition of the propositi

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this book is aimed at the radio serviceman. a chapter is devoted to the testing of receiv ers and the part that oscillators play therein The last chapter describes the various oscil lators that are incorporated in superhetero dyne receivers and how they can be checked Many different laboratory tests are de scribed in the Appendix This book should be of particular interest to the student and laboratory worker who desires a better knowledge of oscillators and signal genera tors The functioning of these instruments is clearly explained without the use of in tricate mathematics and the latter portion of the book should prove of great value (256 pages, 5½ by 8½ inches, illustrated)
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To the trout fisherman, as to few other men, the pleasures of retrospection and anticipation rank high among the fascinations of his favorite sport. The author of

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SCIENTIFIC AMERICAN 24 West 40th Street New York, N. Y. this volume so successfully awakens mem ories of sights, sounds, and smells of the stream as to cause the angler-reader to ruminate nostalgically on piscatorial ad ventures of the past, and simultaneously to anticipate more extensive angling excur sions in the future. The author has aptly said. "It is nothing to those who do not feel it, it is everything to those who do" This is a book packed with sound fishing lore, wrapped tastefully in a series of ex periences concerned with a quest for the giant trout, "The King" W J Schaldach has provided nine illustrations in harmony with the outdoor spirit of the book (221 pages, 5½ by 7¾ inches) - \$2 60 post

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

READERS of this department will recall the description, published here in April, 1939, of a 10" off-axis reflecting tele scope made by Norbert J. Schell, 1019 Third Ave, Beaver Falls, Pa, around an off-axis mirror made by T G Beede, Youngs town, Ohio-a mirror figured the same aif it were a section cut out of a larger mir ror and to one side of the center Figure 1. reproduced from that description, will re call and explain this telescope. In use, it gave refractor performance in a reflector, because diffraction from the diagonal was eliminated, as was astigmatism, the short coming of the crude Herschelian

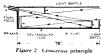
The same team-Schell and Beede-have iow gone one step further—the criss-cross off-axis telescope Schell writes

"Here is a sketch (Figure 2) of the hor rible details, also photographs (Figures 3 and 4) of this telescope as it appears when put together in a rectangular plywood tube The performance is pretty sweet better than the simple off-axis You ask me to tabulate the specific advantages. Here they are:

1. Long focus primary - easier to figure than short focus



The off-axis principle Figure 1



2 Folded back focus, a là Cassegram most convenient observing position

3 Flat only half the size of the primary

-easier to make than full size 4 Tube length only half as long as for us 5 Disposition of surfaces permits light baffles, eliminating any light not reflected

from primary 6 Wooden tube better than metal Also, because of the shape of this tube, most of the light is kept away from sides of the

tube, reducing tube air current troubles "This combination of mirrors can be ar ranged for use of a warmed observing room by shooting the light from the flat up the polar axis -- no added reflections being neces sarv

"This arrangement of a long focus mir ror and half uze flat was thought up by Beede The only part I contributed was to twist the main mirror around 180° and thus bring about the criss-cross feature "No particular trouble was encountered

in getting a good alinement
"The mounting shown was made in a



Figure 3 Criss-cross, in the flesh



Figure 4 Eye end of criss-cross

hurry, to try out this design. It is stiff enough, but no considerations of appear ance went into it

"The 10" mirror works as a section of an maginary paraboloid of 46" diameter This is necessary in order to get far enough off axis to introduce the 6" flat at the position wanted without obstructing the light reaching the primary

"The primary mirror has a 148 1/2" focal length and is offset 19" from the theoretical axis The 6" flat is 67" from the primary and the focus is 81 1/2" from the flat "

ORE of Beede's mirror work "En MORE of Beenes harron work closed," writes Leo J Scanlon, of Valley View Observatory, 186 Van Buren Street, Pissburgh, Pa, "are pictures (Fig. ures 5 and 6) of a 6" Cassegrain telescope the world's best-made for me as a token of appreciation by two other amateurs The 6" mirror and secondary were made by T G Beede of Youngstown, the mount ing, tube, and tripod by Emmor Kelley, of Brownsville, Pa, the of anniversary whistle clock fame see this department, Oct 1938) Beede did a perfect job on the mir rors, and Kelley has produced the finest telescope of his career.

"The tripod has tension-taker-uppers at the headjoint to make it secure. The legs are braced by a special device attached under the tripod head

The tube is of Micarta, cloth base, fin ished in several coats of black Duco rubbed to a satin surface. It is removable from the mounting, this being done by unscrewing the two trunmon bolts Incidentally, these

can't fall out when unscrewed. The cell has a ventilating plate (Figure 5) which can be opened or closed at the turn of a

knob near the eyepiece.
"The yoke was fabricated by welding 2" tee-section steel girders and is exceptionally rigid. The slow motions in RA and declination are velvet smooth and have no blacklash, as there are provisions for eliminat ing this or for applying tension to the bearings in both coordinates. The tripod head and polar axis housing are of cast uluminum

"The only contribution I made to the Scanlon continues, "is the method of adjusting the secondary mirror I gave Kelley the idea and let him work it out-so all the credit for its success belongs to him. The secondary mirror is held by tilted in any direction, or made to approach or recede from the main mirror, by using a screwdriver on three adjusting lugs at the eyepiece end of the telescope, through the holes shown by the arrows (Figure 5) Turning these lugs operates a left-right bushing at the ends of the rods supporting the framework for the secondary framework (Figure 6) slides down into the tube and is guided and spaced by additional lugs bolted to the inside of the tube itself The secondary adjustment is then quite simple, just remove the eyepiece and look in while you adjust with a screwdriver from the rear of the cell. Any slight error of adjustment is immediately corrected. You can



Figure 5. Beede-Kelley to Scanlon



Figure 6: We too think it's great



Figure 7. T. G. Beede testing mirror



line it up perfectly while looking at a star I think it's great!

"Figure 6 also shows the light shield for cutting off direct illumination from the field to the eyepiece, during daytime use-though it is left in permanently

Concerning tubes such as the one used on this telescope, Scanlon writes. "There are two kinds of tubes available at the Westinghouse Company in West Pittsburgh, Pa. One is a laminated Micarta paper tube rolled under pressure on mandrels and glued with a Bakelite varnish The other, also Micarta, is a cloth material wound on a mandrel in similar fashion, same varnish binder of Bakelite cement. Each is baked to harden and is quite as strong as alumi num, without the metallic drawbacks

For several years your scribe has been hearing echos of Beede, of Youngstown, Ohio, mentioned above in connection with two telescope descriptions, generally from the direction of western Pennsylvania. Leo J. Scanlon some time ago told your scribe that he was an old-time worker of most remarkable skill. N. J. Schell, mentioned above, also discovered him and so did others. Yet, never a written word or a syllable came from the man himself, until one began almost to believe him legendary. like Homer Thanks to Schell, who has now provided some requested personality notes, and to Beede's sidekick, Leo F. Grandmontagne, Box 833, Youngstown, Ohio, who finally managed to get him to submit peaceably to being photographed (Figures 7 and 8). Beede comes at last into focus.

He is about 68 years old, a retired master

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that there is a companion volume to "Amateur Telescope Making."

"Amateur Telescope Making — Advanced" has 57 chapters, 650 pages, 359 illustrations and over 300, 000 words, dealing with advanced mirror technic, flat making, eyepiece w or k, drives, aluminizing, observatories and many other aspects of the optical hobby. Published 1937.

"Amateur Telescope Making — Advanced"

Edited by Albert G Ingalls

Postpaid \$3.00, domestic \$3.35, foreign

SCIENTIFIC AMERICAN 24 West 40th Street, New York, N. Y.

plumber and plumbing contractor, and started making mirrors in 1898, after visiting an elderly clergyman named Dr John Peate, of Greenville, Pa. who, after 16 years of mirror making, had cast a 62" mirror, said now to be at the Smithsonian Institution He has been making mirrors ever since, mostly as an amateur was once visited by Prof Ritchey "B "Beede does not hurry his work," Schell states. "but when he turns a job loose you can swear by it On jobs, such as flats, his methods are tried and sure, and he carries them through without any back-tracking, and in surprisingly short time considering the quality of the finished product. He does all his work by hand

"He has ha own methods of preparing Carbo and rouge." Shell contunes, adding, "I have seen some of ha Carbo that he has floated three hours. He does not use emery for finishing, saying it see solely, and that the fine Carbo produces a better surface anyway. He floats his rouge and classifies anyway the floats his rouge and classifies anyway with a pen kinfe that look like the displays with a pen kinfe that look like the displays with a pen kinfe that look like the kinds of wax he uses coal far pitch."

Berde is said to have a ken sine of humor despite he relaxed expressions of the photographs. "He is an indefanguable sorder, with unlimited patience," Schell states, and can produce a heautiful, smooth optical surface of any kind whatever with perfect edges and correct within limits to close to measure with the kinfeedge test, and do it right along He is considered by a host of amisters who know him as the dean of amateur telescope makers. The Mahoning Valley Academy of Seence is preparing to honor him for his development of a method for figuring off asymmetrics.

"Why hasn't Beede ever told the world about himself?" Schell was asked "He is by no means gubby" was the reply, an under statement.

CREDIT is due to William R. Harlow, an anative relevance make and fresh man at Miami University. Oxford, Olino, for invention consisting essentially of the application of a stroboscope to a telescope, for improving definition when observing. Prof. A. E. Douglass, director of the Stew and Observators at the University of Arrona, who has had many years of actual experience at the eyepter on observing Mara both there and at Lowell Observatory, states that the believes the deef fruitful, and it is hoped that other annateurs better strated for trung it out than Harlow will

now do so Harlow states that he has made a 6" reflector, a 10" Cassegrainian, a 6" simple refractor, and then an 8" achromatic refractor, working on the last named from J R Haviland's instructions in "ATMA" Then he tackled his stroboscopic application "A careful examination of the shimmering of an image," he states, "will show that about 75 percent of it is harmonic, the remaining 25 percent erratic, due to the varying air currents." These things are described by Prof Douglass in his chapter on "Atmosphere, Telescope and Observer," in "ATMA" "If some form of stroboscopic disk is interposed somewhere along the light beam." Harlow continues, "with a rheostat control on the disk motor, a lot of shimmering will be stopped.

"The alot is the disk should be a tride wider than the light beam at the point along the tube where it is applied. With one alot (Figure 9, upper left) a speed of half the motion of the image will stop it, it with two slots (upper right) quarter the speed, and so on I found it worked best at the declination axis, where the whits toon was least. The motor should be cush-mored in some way."

Perhaps one's first thought on noting this description is "But won't the illumina tion of the image he greatly reduced". No, it would not, as Harlow explains, "because of the perastence of vision—though this would be detrimental in photography where there, we on such histography

J R Haviland, to whom this communication was shown, thought "it really is something, if it works." Professor Douglass

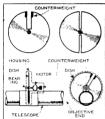


Figure 9 Harlow's strobotelescope

commented as follows "I am a lot interested in Harlow's stroboscopic device am satisfied that a substantial amount of the flicker in the image is harmonic think this applies to a star or small object like a satellite of Jupiter [One of Professor Douglass' specialties is the observation of Jupiter's satellites Another is tree ring research, he is the scientist who has dated many old Indian structures in the southwest by means of the rings in the timbers found in their ruins -Ed | I suspect that, in the case of a disk the size of Mars", Professor Douglass continues, "the situation is most complicated Atmospheric currents are not so easy to study on a planetary disk as on a

star "Harlow's stroboscopic device will work when the telescope lens is small compared with the wave of the currents in the air for then you have good definition (but low power, limited by diffraction effects) and a swaying image This stroboscopic device would decrease or stop the swaying of the image and is a very neat idea, but in a larger aperture which covers several or many waves at once this device, as described, would not aid because the image does not sway but is badly confused due to the varying refraction of the many slopes of the air waves, all in the objective at once "So the device should work for a small telescope, 2 or 3, and sometimes 4 or 5, inches, depending on large size of air waves and freedom from cross-currents or local currents (which I used to call ripples).

but with increasing aperture (5 to 10

inches) the results might or might not be

good (I am thinking of conditions in a

good climate such as here in Arizona). For bigger instruments, up to the grant reflectors, it would do no good at all. However, the idea is fruitful. Is there any way some harmonic correcting device could be made to work in a big aperture? For example On an observation night make a sketch or a photo of the waves as seen with out the eveniece and in full anerture, transfer this to some dichromated gelatin photographic film on good glass, that displays variable thickness of film without blackening, insert this in the beam and have it vibrate transversely to the waves on a motion found to match the shifting of the waves themselves. This would be very difficult. It might better be tried the follow ing way Make a film for choose one of a lot on hand), place it in the beam (by mo tion along the beam it might adapt itself to the proper size-refractive power of wave slopes would be more difficult to match). and then add the stroboscopic slit of Harlow's, adapting the rate to match the wave changes

"Thus, in short, if a transparent pattern could be made to effect wave correction in some one position of the waves with refer ence to the telescope lens, then the application of Harlow's stroboscopic device could, I think, be made to pick out the majority of the instants of time when that correction would be an advantage either in photography or visual work "

Commenting on this, Harlow states that he has no facilities to carry the idea further. hence the idea is presented here for other amateurs or professionals to carry on Har low adds that he had himself discovered what Prof Douglass pointed out-that the effect diminished as the aperture increased and that he had had better results with his 3" refractor than with his 8" reflector and 10" (assegramman, but had not known whether or not this would always be true

WHETHER reflectors with open tubes are superior to those with closed tubes is the subject of a perennial debate. Most recent slant on this is found in the Janu ary number of The Journal of the British Astronomical Association, where Dr W H Steavenson's opinion is pointed out For a telescope which is to be used in the open, the disadvantages of the closed tube would be outweighed by the advantages Most lattice tubes are used under domes, but if used in the open, dewing of the mirror may occur Two other members pointed out that they find that aluminized flats do not dew in the way that silver flats would under the same conditions.

The same number of The Journal contains a six page article by M. A Ellison, son of the late Rev W. F. A. Ellison, describing a Hale spectrohelioscope which he has just completed. This is the second in Great Britain, (by an amateur), A M Newbegin having made the first, two or three years ago M. A Ellison says the work required two and one half years, and that the performance has come up to expectations.

THE TELESCOPE, popular astronom ical journal, March April number, has a noteworthy, 10-page article on the 200" reflector, by Anderson and Porter. Two thin dimes, Harvard College Observatory, Cambridge, Mass.

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LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar

CORPORATE NAMES

WE have previously pointed out on this use his name in connection with the operation of his business is not without legal restrictions. Thus, where a person habuilt up a large business under his family mame and the name has become identified in the minds of the purchasing public with his business and product, a new-country having the same name is not permitted to use his name in connection with a competing business, at least without an accompany ing statement explaining that there is no

connection between the parties The courts are even stricter in applying this principle to the use of a family or personal name by a corporation. This is illustrated by a recent case in the New York State Supreme Court involving a well known designer of dresses. The complainant in the suit was the seller of gowns and dresses made by a well-known designer named Turner and the gowns were known variously as Turner's Gowns or Turner's Creations Defendant was a corporation engaged in the business of selling dresses and it adopted the name "Turner's Gowns Limited" The defendant acquired its name from one of its incorpo rators whose name at that time was Pauline Jacobs but who had previously been mar ried to a man named Turner Since the incorporator's name at one time was Paul ine Turner it was argued that the defend ant corporation had the right to use the name Turner as part of its corporate name The Court held that a corporation may not adopt the name of an individual incorporator and use it to deceive the public or to defraud others who have built up a business under the same name. An injunction was granted, restraining further use of the

EQUITABLE MORALITY

It is axiomatic that he who seeks the aid of a court of equity must come into court with clean hands. In other words, a court of equity will not give aid to a person who has acted inequitably with reference to the subject matter of the dispute that he is asking the court to act upon.

A recent case based upon this principle illustrates that the courts have not as yet been affected by the vide-spread public midflerence to or toleration of gambling The manufacturer of a game of chance smaller to a lottery brought suit for trademark infringement and unamather than the same of the same of

grounds that the plaintiff was guilty of unclean hands in that he was using the trade mark in connection with the sale of a gambling device. The Court sustained this contention and dismissed the complaint, stating.

"In this case the complaint shows on its face that the complainant seeks the aid of a court of equity in the use of a device universally condemned as injuntous."

SAWDUST HEELS

PATENT for a shoe heel made pri marily from sawdust was recently held to be valid and infringed by a federal district court. The owner of the patent brought suit against a shoe manufacturer charging that he was using a heel which infringed the patent. The patent covered a heel comprising a molded block of saw dust and a soluble binder saturated with nitro cellulose. In making the heel the patent suggested mixing hardwood sawdust with glue and then shaping it in a suitable mold under pressure When the molding operation was completed the heel was then soaked in mire cellulose. The Court found that the patented heel was new and repre sented an improvement over prior com position heels and accordingly held the patent to be valid

CONCEALMENT

THE patent laws provide that in any auit for patent infringement there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the suit. One of the purposes of the law is to prevent a patentee from unfairly permitting an innocent infringer to infringe a patent for many years and then, after the infringement has been built up to substantial amounts, bring suit for patent infringe ment and recover large damages. However, this provision of law appears at times to work a hardship on a patentee This is il lustrated by a recent suit for patent in fringement in which the infringement or curred more than aix years prior to the institution of the suit.

The patentee contended that the infringer concealed the infringement from him and accordingly he was not in a position to mat ute the suit at an earlier date It was argued by the patentee that the surveyar period should be computed from the time that he received actual knowledge of the infringement and not from the actual date of infringement. The Court throughout the infringement and her than the previation of the court of the provision of the court of the provision of the court o

any years prior to the institution of a suit, even though the unfrangement might have been concealed. This provision of law accordingly places a rather harsh burden of vigilance upon a patentee; he must den of vigilance upon a patentee; he must mot only file suit promptly against a person mot only file suit promptly against a person who openly infringes has patent but also he must discover and prosecute those who are fraudulently and secretly infringing has

STRICT CONSTRUCTION

A PATENT that has not gone toto comnected use a commonly referred to as a puper patent and a strictly construed by the court. Thus a libraried by a suit for infringement of a patent for a method for heating electro-conductive materials in electric welding machines. The patents charged that the manufacturer and users of a spot-welding machine infringed the material is suit.

It was possible out to the Court by the defendant that there were decided differences between the patients machine and proposed of the patients of the patients of the patient of the pati

In reaching its conclusion, the Court

"Moreover, considering Thompson's patent as a paper patent, for there is no proof of any commercial use, it must be strictly construed"

INTERURBAN

A FEDERAL court recently held that a manufacturer of street sign using the name. "Manufacturer of street sign using the name "Modified prevent a competitor from using the word "City" in its corporate name Both of the parties were engaged in the manufacture and sale of highway signs and their principal customers were state governments, municipalities, and other political subdivisions. The plantiffs corporate name was "Municipal Street Sign Company, Inc." and the defendant's corporate name was "City Street Sign Corporation."

The plaintiff contended that the similarity between the two names would lead to confusion among customers. The Court rejected this contention, however, pointing out that they did not sell to the general public but to government officials who were well informed about the companies from whom they purchased equipment

In this connection the Court made the following statement

"We must not forget that it is not the general public that is the purchaser of street sign, but that the purchasers thereof are officials and engineers of public sub-divisions of the State, who would ordinarily also well informed about the company from whom they were purchasing, and would not be deceived by names of such different sounds, even although the meaning of them might be the same,"

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The

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Current Bulletin Briefs

Logal High-Lights

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Flooroscopic Inspection is Being Widely Used to Reveal the Presence of Poreign Objects and the Condition of Pood Products Welcome, Fisherman!
In the Spring — Skeet
Who!'ll Raise the Cane?
"All-American" Trout Files
Pot-Shots at Things New For Better Roads-By Thomas H. MacDonald Extensive Studies of Present Highways, Including Sight Distance, Traffic Quantity Traffic Speed, and So On, Purnish Data to Aid Future Planning Camera Angles Abing the Masters
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(because of the peculiarities of perspective) deadly weapon at long range. It is part of the permanent defenses of the Panama Canal. Because of its emplacement on land, it is more accurate than would be a similar gun on an attacking battleship. See also page 324

SCHEMETTED ARESTORAY. Date: 1965 Vol. No. 188, No. 6 entered at the New York, N Y, Pert Office as pround class manter June 29, 1879, under the set of Manch Art. (March Art Schemers, 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of Manch Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the Schemers of March Art. (March Art. 1984) with the

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50 Years Ago in . . .



(Condensed From Issues of June, 1890)

CENSUS.—"Americans who are loudest in their groamings about several crinise questions should look at the inquisition to which the Germans are subjected. The German vear book gives the figures of even the mome tax. The exact rental of each deeling is obtained, and the average rentals for different conditions are published:

AIR-IIIP.—The aerul caiamaran herewith represented. . . bas two cylinders adapted to hold a buyann material, and connected by a light frame beneath which as stretched a platform of wore steel were supporting an electric or other motor designed to drive a rearwardly extending shaft which operates two propeller blides. To the outer state of the reduction are supported wings, protably



mounted on hormontal shafts, the wings carrying racks engaged by annular gears in guideways carried by the evinders, whereby the wings may be inclined at such angle to the hormontal line as may be disarted in operation it is designed that the cylinders shall be just sufficiently bosonal to not quite overcome the attraction of gravity, when, the wings hering set at the desurement of the property of the the upward and downward motion being regulated by the inclination of the weigs.

HOW TIMES (HANGED—"In a recent speech Congressman Atkinson, of West Augman, said. 'If all the ports of entry on both oceans were to day blockaded so that no vessel could enter them bearing the products of other countries, and war should be declared against us, we could, with our present facilities, produce every munition of war, and every article that we might need for our sustenance for a thousand years' of

SAFETY—"The recent experiences of several aircumer plying between New York and Laverpool gave renewed emphasis to the call for the invention of new and improved constructions and applications of the fall of the construction of the hulls, in means to ascertain the vicinity of section in fog., in animate devices for quickly turning and stopping the vicinity of the properties of the propert

WRITING AT A DISTANCE—"One of the marvels of electricity, and one of the most striking of the Edition exhibits at the Paris exposition, was the little instrument which enables the operator to sign a check 100 miles datant. The writing to be transmitted is impressed on soft paper with an ordinary sivilus. This is mounted on a cylinder, which, as it revolves, makes and breaks the electric current by means of the varying indentations on the paper. At the recoving end of the wire a similar cylinder, moving in accurate prepared paper, on which it transcribes the signatures in black letters on a which ground."

SMELLS—"By the reaction of sulphurged objection are too in the presence of the reaction and parts as obstanted principally tribuoacetin Citlass, and small quantities of a non-volatile, definited, crystalline compound CallaSs, tertathopeution. At the same time, however, an exceedingly volatile body is formed which possesses as mell so horroble that, in comparison therewish, ethyl mercaptan, ethyleumercaptan, and other volatile sulphides must be considered as fault such as the same time.

POWER.—The utility of wire rope transmission of power habecome widely recognized. Not only among the rugget fully and mountains of the East and far West where streams go roshing down through cavers and rocky steeps, where no locations for mills or factories are afforded, in this means of transmission of precous power appreciated, but it is so convenient to use it that we find on the prairies of the West mills being operated at a long distance from water powers by the wire rope. A few days ago, on a truy through, Nebraska, we noticed a rope stretching for nearly a mile from a water power to amill that had recently been built adjourned as a railroad, the owners finding it much more to their advantage to have it there, with the switching privileges afforded, than at the dam. The expense of hashing the flour which is thus saved to them will very soon pay for the system of power transmission."

MENTAL CRIPPLES.—"The hardest thing to get on with in this life is a man's own self. A cross, selfish fellow, a desponding and complaining fellow, a timud and care-burdened man—these are all born deformed on the inside. They do not limp, but their thoughts sometimes do.

AND NOW FOR THE FUTURE

¶"America's Winged Weapons," a succinct survey of the planes of our national defense forces. By James L. H. Peck.

Seeing with electricity. How the electron microscope works. By Jean Harrington

¶ Fighting a war of grinding attrition against friction, man's friendly enemy. By Walter L. Finlay.

¶ Sulfuric acid Its expanding uses measure the progress of nations. By William H. Waggaman

Watch for our new editorial feature. Browsing With the Editor. Significant facts from the broad field of science and industry.



What's Your Telephone Score?

EVERY DAY many pleasant voices go over the telephone. And it seems to us the number 18 growing. For most people realize the business

and social value of "The Voice with a Smile." Sometimes what may appear like a gruff or hasty manner is not meant that way at all, but is simply carclessness or thoughtlessness. Since this is the age of quizzes, how about a short one on some

points of telephone usage?



Do You Talk Directly Into the Telephone?

The proper way to use the telephone for best results is to hold the transmitter directly in front of the lips while you are talking.



Do You Speak Pleasantly?

Remember . . . it may be your best friend or best customer. Greet him as pleasantly as if you were face to face. Pleasant people get the most fun out of life anyway.



Do You Hang Up Gently?

Slamming the receiver may seem discourteous to the person to whom you have been talking. You don't mean it, of course, but it may leave the wrong impression.



Do You Talk Naturally?

Your normal tone of voice is best. Whispered words are indistinct. Shouting distorts the voice and may make it gruff and unpleasant.



Do You Answer Promptly?

Most people do. Delay in answering may mean that you miss an important call. The person calling may decide that no one is there and hang up.



"The Voice with a Smile"

can be a real asset. Haven't you often said of some one who has Just telephoned — "My, but she has a pleasant voice." Or —"I like to do business with them because they are so nice over the telephone."

It's contagious too. When some one speaks pleasantly to you, it's easy to answer in the

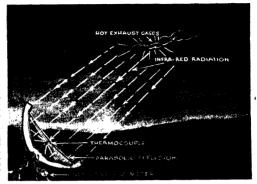
same manner. Many times you form your impression of people-and they judge you - by the sound of a voice over

the telephone. BELL TELEPHONE SYSTEM



LONG RANGE DEFENSE

PROVIDED we have enough of them, the Army's 16-inch guns could stand off any enemy, for they out-range and out-shot smillsr guns on battleships. High elevation gives greater range, while steady, land mounting gives greater accuracy. They kurl shells weighing over a ton more than 30,000 yards.



To detect approach of a plane whose engines are cut off as it glides silently toward its objective, the tool which astronomers use to measure heat of distant stars might be adapted to mittery use The thermocouple at the focus of the reflector would be affected by heat thrown off from the distant plane and the resulting current noted on a sensitive volumeter. Even the warm afr from a gliding sirplane might be detected with this

Inventions Win Wars

Suggested Developments... To Detect, Defeat Warplanes, Submarines... Humanitarian Aspects... Physical Principles Which Inventors Must Follow

By MAJOR WILLIAM H. WENSTROM

When today in the midst of a world-wide struggle, declared and undeclared, between peace-loving democracies and aggressive totalitarians. The sympathies of most Americans, needless to say, are with those nations which are struggling for "life, liberty, and the pursuit of happiness."

However they may lag behind in the matter of armament, regimentation, and general blood-thirstiness, democracies which encourage free and inquiring minds among their citizens should at least excel in the very important quality of ingenuity. American free-lance inventors, for example, are renowned the world over for their intelligence, persistence, unconventionality, and sheer weight of numbers And however we Americans may hate the macabre business of war itself, there is plenty of sober reason, these days, for American inventors to give serious thought to military and naval inventions. Inventions that serve to check those premier weapons of sudden and socret attack-the warplane and the submarine-may even classify as works of true humanitarismsm. Herein are a few suggestions. Though most of

the basic ideas suggested to American military-minded free-lances in this article are essentially simple, their practical development would, needless to say, entail plenty of painstaking technical

As to possible war-winning inventions, the inventor can save himself no end of time and trouble at the start by writing off the slate as illusory the three weapons most dear to the hearts of feature writers and move scenarists: (1) a super-power jud explosive; and (3) a "Geath ray" capable of killing men, or disabiling tanks, sirplanes, or ships at a distance.

D EVELOPING either a super-lethal gas or a super-powerful explosive in hazardous enough in a large plant equipped with adequate safeguards. For the average free-lance, such work would be prohibitively dangerous. Despite all the organized research lavished on these two projects, so far as I know, no new wartune gases have been developed since 1918, and "atomite" (the latest high explosive) is only a third more powerful than 1918 trintrobloulo, or Third more p

In principle, the much publicized "death rax" perhaps first described by H. G. Wells in his faintastic story of invaling Martians, is simply a closely compacted beam of electro-magnetic radiation, or radio waves. The wavelength depends on the target, which must "resonate" to it for maximum current and voltage effects within itself. For mairgets, a wavelength of 3 to 4 (or 1½ to 2) meters might be used. For average warplane-targets, a wavelength of about 40 (or 20) meters might be suitable (assuming 65 feet wing spreads).

Very simple, so far Bugs and mice. perhaps, actually have been killed with 'death rays" of a sort. All you have to do, to bring down a German bomber flying over London, say, is to direct upon it a sufficiently powerful radio beam at perhaps 20 meters wavelength, or 15 megacycles per second frequency But wait a minute There is the slight consideration of electric power To bring down that German bomber by this method may take about all the electric power in Great Britain, or possibly all the power in the British Empire, to say nothing of a lot of super-powerful vacuum tubes as yet undeveloped Perhaps it would be simpler and cheaper, after all. to shoot that bomber down with a battery of very efficient British 3.7-inch anti-aircraft cannon

The standard airplane locator, in wide use by the world's armies today, is a very simple device operating on the principle of audio frequencies or sound waves.

In the regular military instrument, a cluster of four large horns is mounted on a universal pivot, the mouths of the horns being pointed at the noise-producing airplane, and the small ends of the horns being led to earphones on two men. either with or without the aid of audio amplifiers. The horns are then in effect two pairs of magnifying cars, one pair giving the plane's azimuth angle, and the other pair its altitude angle. An airplane can be detected and located by this device at distances of 10 miles or more, provided that the airplane's propeller. as well as its motor, is turning over at somewhere near normal revolutions

Silencing the arplane engine alone one not aword detertors for at modern high speeds most arplane move actually comes from the propelly if the pilot frontiles back his engines, however, and glides silently in towards his objective from high altitude that is a lores of a different color which calls for a location of radically different design. Even so, the standard audio locator still has a fleeting chance because the pilot must occasionally "gun his motors unless he wishes them to choke up

Telescopes and binoculars are, of course, widely used but their are defiinte and rather low limits to distantseing by this means. This limitation is largely due to the extreme shortness of light waves compared with the molecular structure of the atmosphere and of the nattices, suspended in it.

In ordinary diffused haze, yellow hilters on binoculars help slightly Red differs, passing only the longest visual wavelengths, help considerably, they are, in fact, standard practice for all longerange aerial photography. But through very dense haze or fog, or clouds, involving larger particles of higher solutions of the properties of the able is to see Nor's near infra red photography much more effective. Anyone who has ever tided in a high-powered arrilane at might has noticed large hive flames streaming backward out of the engine exhaust ports. These flames mean plenty of heat for infrared i radiation — on a wavelength somewhere around one thousandh of a centimeter. Hot, exposed cylinders or radiators also mean infrared radiation, and so does even the warm air streaming backward from these parts.

The most sensitive known detector of heat waves is the thermocouple - an electrical unoction between two wires of dissimilar metals. For maximum sensi tivity and directional effect, the thermocouple itself is placed at the focus of a large parabolic reflector. Such an arrangement can be made so amazingly sensitive that it will indicate the heat radiated by a candle several miles away For airplane-locating, two or three of these thermocouple units each mounted on horizontal and vertical degree-scales similar to those on a theodolite might be set up at known ground locations. The airplane's position in free space would then be found by triangulation

A another possibility in airplane de tection-and location rather remote at the present time, how about using electro-magnetic waves still longer than infra red - ultra-short radio waves of a wavelength say, somewhere around half a meter, or 50 centimeters? Or posibly somewhat longer waves around 5 meters? On the 5 meter waves, the design of a transmitter and receiver cor cuts is easier and cheaper. But on the 50-centimeter waves, necessary parabolic reflectors beam antennas, and other arrangements for three-dimensional direction finding receivers are more compact, easier to handle, and less expensive. The general idea is somewhat similar to the new radio echo altimeter used on modern airliners, operated in reverse. Radio engineers and amateurs have already noticed occasional queer ultrashort-wave radio "reflections" that seemed to come from airplanes passing overhead.

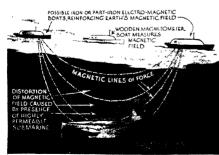
Suppose we have, in the center of Lon don, say, a high-power, ultra-short-wave radio transmitter capable of sending out periodically repeated short tick signals of some characteristic form Suppose we have, further, in the surrounding countryside, at distances of 20 or 50 miles outside the city, several suitable radio receivers, preferably of directional type. The receivers could be elevated to get both direct signals and those reflected from high-flying planes, or they could be placed beyond the bulge of the hori zon where signals will be received only by reflection from airolanes. (The direct signals would be useful for timing, but might cause too much interference with the reflected signals.) In either case, two or three directional receivers might be able to locate the enemy airplanes



Anti-aircraft battery in action, with equipment to direct artillery fire

closely enough to hang up an effective H-E barrage. Or the triangulation imight be made indirectly from time differences

Submarines are particularly menaing to nations whose security depends on sea power — nations such as Great Britain and the United States. The standard method of locating submarines from surface patrol boats, derived from 1918 practice, depends on the underwater transmission of the noise from a submarine's propeller. The sound pick-up is a binaural pair of under-water microphones, preferably spaced several feet



A silent submarine on ocean bottom would indicate its presence by diverting magnetic lines between two specially equipped ships, as the author explains

apart, and similar in principle to a pair of under-water ears.

This method is wholly dependent upon the submarine's manisums some upon the submarine's manisums some engine revolutions, which it must do to manitain depth in deep waters such as most of the Caribbean Sea or the Pacific Ocean But in shallow waters, such as the American or European constal areas of the Atlantic, a sub can he quettly on the bottom for hours at a time, undesticated by ordnary hydrophone methods

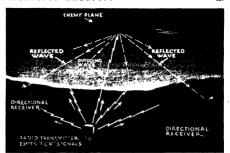


Echo-sounding equipment could be used to locate hidden enemy subs

But asale from these present methods, there are two physical principles by which we might make the submarine disclose its presence involuntarily even it is not obliging enough to turn over its propeller. One is the principle of underwater sound reflection now in standard use as echo sounding gear on most warships and many larger merchantmen.

Standard echo-sounding apparatus records a continuous graphical trace of the bottom over which the ship is cruising - by sending out a sound tick from an underwater "loudspeaker" (repeat ed at intervals of about a second) and measuring the time it takes the tick to travel (at about 5000 feet per second) first down to the bottom, whence it is reflected, and then back upward to an under water microphone on the ship. Set for 100-fathom maximum depth, the or dinary echo sounding gear traces a continuous profile of the bottom as the ship steams ahead at full speed, and clearly indicates a rock, a ledge, or other ob struction on a level bottom, provided the obstruction has a height of at least five fathoms (30 feet). This is somewhat more than the height of a submerged submarine lying on the bottom.

An ultra-sensitive echo-sounding set, with magnified depth change indication, could perhaps be installed as standard



"Tick" signals sent out regularly by short wave would be reflected by an unseen plane picked up by several stations, and the plane then located by triangulation

equipment on submarine-chasing patriol boats. Where a submarine is supercived of lying quirtly on the hottom the patriol boat could cross and rections over the suspected area at high speed in anisohly the continuously. Whenever a small peak on the depth curve indicated a bottom-hugging U boat, depth charges could be let go. Of the course and submerged rocks ledges on wreeks should if possible, be charted in advance, lets they give false a larms.

There is still another physical principle that might be used in locating submerged and silent U-boats magnetism and permeability. The compment is quired here would be considerable - in addition to the usual armed natrol boats. a small wooden ship completely nonmagnetic and equipped with ultra-sen sitive recording or indicating magnetom eters. And possibly two additional part-fron craft equipped with ships powerful electric generators and wire wound so that the whole boat is nothing more than a powerful electro magnet of the bar type

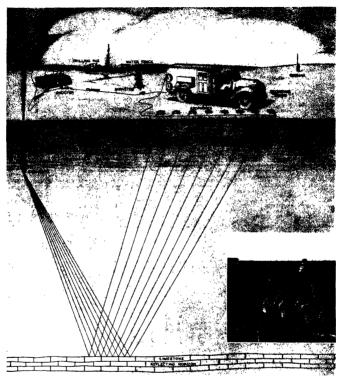
EVERY student in college physics has performed the experiment of drawing on paper, by means of iron filings or small compasses, the magnetic field between two bar magnets, and every student knows, too, that introduc ing a piece of highly permeable substance, such as iron or steel into this magnetic field will tend to pull the lines of force into itself, thereby distorting the nearby lines of force Very well then -- suppose a submarine is lying on the bottom at a depth less than 50 fathoms (300 feet) The wooden magnetometer ship cruses around the suspected area on the surface, making precise magnetic measurements of the earth's field with ultra-sensitive indicating or recording magnetometers. In the vicin ity of the submarine (and most notice

ably, directly above it) the magnetometers should show a sudden change in the direction or intensity of the earth's field due to lines of force being distorted towards the submanine by its high magnetic permeability.

As an alternative method, considerable more complexed but possibly more effective, the two partaron electromagnet shape could be formed in column perhaps 500 yards or so apart, N (how) pole of rear ship indeed up with S (stern) pole of leading ship, the local magnetic held so created preferably reinforcing, so far as possible, the earth's produced to the product of the product o

The magnetic method would, of course, he slower and more complex than the echo sounding method. But being immunit from the blandishments of rocks and ledges it would perhaps be more certain, except for faulty indications due to any submerged wrecks of iron and steel slups. If you want to succeed as a free-lance

inventor, in war or peace, don't follow the customary and well trodden paths there the great laboratories and the formal organizations naturally have you heked from the start. But remember also that most of these organization scientists and team technicians have to keep their noses very deep in their own particular little ruts so that often they have neither the time nor the energy to see the woods for the trees. So Mr Free-Lance, keep your eye on the woods as a whole, keep your viewpoint fresh and unjaded, and look for the new angles the at-first-sight-impossible angles, the angles that will drive quickly around those too-well-known stone walls into which big research teams are butting their collective heads



Set-up of equipment for seismographing and, inset, placing the seismometers

Seismographing For Oil

THE esimilary has been made in the search for new petroleum deposits derives directly from the seismigraph employed in earthquake seismology to record the location and intensity of earthquake shocks Seismographs have been used by the oil mulusty for many years and have aided in the discovery of some of the world's greatest oil fields

At the present time exploratory crews sent out by The Atlantic Refining Company are employing seismographs in an area in northeast Texas to determine the location of underground formations of the type in which oil is usually found.

In modern esismographic reflection shooting a charge of dynamic is placed in a hole drilled to a depth of from 40 to 100 feet The firing of the charge creates a sound wave which spreads out in all directions Each time the wave encounters a different reflecting statum a small amount of energy is reflected back toward the surface.

The reflected vubrations are picked up by sessmometers or geophones, amplified by vacuum tubes, and photographic on a strip of paper Study of the photographic record, including the time it takes for the sound wave to reach the various strata and be reflected back again, makes it possible to chart the geologic characteristics of the subsurface. The charts, in turn, lend themselves to the selection of drilling attes over formations of a type favorable to oil deposits.

OUR POINT OF VIEW

Patent Sesqui-Centennial

SAMUEL HOPKINS, of Vermont, was granted the first United States patent in 1790. That was just 180 years ago this year. In the years since then there have been a total of more than 2,200,000 patents. Only 9957 of these were granted before the patent system was reviewed and refined in 1836, but in the last 50 years alone, 1,799,000 were granted, or more than four times as many as in the first hundred years.

This evidence of the importance and "workability" of our patent system makes difficult of understanding the many attacks levelled at it in recent years. That the protection it affords the inventor has spurred the enterprise of the nation seems conclusively proved. And why not? It was set up "To promote the progress of science and useful arts by securing

to inventors the exclusive rights to their discoveries." Those exclusive rights have provided the incentive for wast developments in many fields, has given us numerous new industries, and promises to give us many more. The example of one automobile manufacturer, The Ford Motor Company, is illuminating. Commenting on the 28,000,000, Ford, the New York Times and that, since 1903, the Ford Motor Company has paid out in wages 44,220,000,000, purchased materials costing \$10,000,000,000, while the government has received taxes of \$70,000,000.

Multiply these figures by the number of cars of all makes produced, and by all the other new industries made by inventions of new things or of improvements on old ones, and the picture is extraordinarily impressive. Invention and the safequards of the Patient System are the basis for this year success.

Perhaps changes in the Patent System may be necessary. They should not, however, be made willy-nilly by politicians. They should be made only after thorough and judicious study of the facts by experts, not as a result of prejudice by dilettantes and social reformers. It has been a good system that has poured until billions of oldiars into the pockets of farmers and miners, investors and wage-earners, all those who have been and are touched by the fingers of our enromous industrial system. It should not be cast aside lightly, nor ripped apart by unwee hands $\sim FDM$

Opportunity

PART of this month's piece on the current and important question of television, supplementing that on page 265 of last month's issue, takes the form of a one-act playlet of comedy and pathos (All dialog is fitthcome, based on fact)

Federal Communications Commission "You television experimenters have shown some progress, so we are going to let you put on semi-commercial programs, starting next fall " Radio Corporation of America "Whee' Let's go, boys"

Radio Corporation of America white: Let's go, boys Business of preparing and publishing advertisements of television receivers, telling what has been accomplished and what is m store for lookers-in Also of reducing prices so that John Public will be better able to purchase receivers

FCC: "Stop! You have been had boys We don't like your advertising. You are actually trying to get the public to buy your equipment. You have taken advantage of our ruling. We take it all back. You can't go on commercial schedule until we investigate you and find out why you actually want to sell receivers."

Curtain.

In the figurative lobby after the show, a member of the commission made the following statement, as reported by the daily press. "Should the market be saturated with 30,000 receivers of one manufacturer, sold on the installment plan and promoted by a sales campaign and pep talks, any other set maker entering the market at a later date would be handicapped and retarded, wouldn't be?"

Wouldn't he? You're darn't tooting he would! And why shouldn't he "handicapped and retarded." Since when has the American business method been to wait until all late comers have had an opportunity to take every advantage of the pioneering work done by others? Since when has it been the practice to penalize instatute and gumption, to crack down on those who have blazed the trail, and to hand ready-made success to Johnnies-come-lately?

Television has always had a warm spot in our heart. We have watched it from the time when it was a pup, its eyes literally unopened. We have seen it take its first staggering steep, its eyes util far from perfection. We have rejoiced at its first blurry successes, its first crude and flickering pictures. We have drunk a toast to its 441-line pictures that were good. We uttered a cheer when the FCC said go ahead. And now comes the ultimatum that the pioneers in the art cannot reap where they have sown, for fear that someone else in the industry may be "handeapped and retarded."

Words fail us, our typewriter stutters in protest at the words we would put on paper "Handcapped and restrade", indied "It is high time that cutzens of this country, official and private, awakened to the fact that business and industrial progress must not be penalized by bureaucratic methods which profess must not the penalized by bureaucratic methods which profess must not be penalized by bureaucratic methods which profess must not be penalized by bureaucratic methods which profess must not be penalized by bureaucratic methods to be sufficient to the profession of the profession o

Let's Look At It Selfishly

WHEN an argument arises as to whether or not it is right and proper that American aircraft factories should supply planes to foreign nations, there is one phase of the situation that should not be forgotten

Whether in peace or war, it is highly desirable that this nation should have available the best possible aircraft. In peace, we need reliable air tetransportation, in war, we need the finest available air defense. The only way in which these ends can be achieved is through experience—experience in design, in construction, in flying. It should be obvious that neither the transportation industry of this country, nor its military forces, can afford to spend more than a certain maximum in acquiring this experience. If, however, foreign nations purchase our airplanes in large numbers, we become the gamers in more ways than one.

First A profit is realized on each sale, part of which may be turned back into the industry for research in improved designs. Second This constant improvement in design will keep us one step or more ahead of possible enemies. Third. More orders mean greater production facilities which, in turn, place us in a highly advantageous position in case of trouble. Fourth, and most important of all. Operation of surcrett under wartime conditions reveals needed improvements that make these be found under ruttine testing.

mign never be common under fortune teaming. Every thinking American succeedy hopes that the United States will be able to keep out of foreign entanglements; at the same time, he realizes that we must be prepared at all times to defend our own country when and if the pressure becomes to great. With aerial warfare daily becoming a more important part of the military scheme of things, it behooves us to keep our powder dry. We can best do this, as far as ar power is concerned, by taking our profit in the foreign market and applying at to the upbuilding of our own air equipment.—O. D. M.

HISTORY IN A BOG

ORESTRY is a long time proposi tion. The lumbering industry a hundred years hence will depend upon forests which are started this year When agricultural crops prove unsuited to a region they can be changed the next year, but by the time forest crops are found to be unsuited to a region many, perhaps costly, years have elapsed Therefore, the forester must exert every effort to determine that his forests will as nearly as can be foretold, successfully come to maturity Careful calculations may be upset by accidents such as fires and insect epidemics, but climate is the chief controlling factor in the establishment and survival of forests. To assure some certainty of success in forest management it is therefore necessary to have some certainty of the kind of climate the forest must endure in the next hundred years. This may seem impossible, but weather is known to run in cycles, and if you know the weather of the past you can calculate that of the future with fair accuracy

There are two methods of determining general weather conditions over periods of hundreds or even thousand-of years. First, analysis of tree rings, a process which can predict weather cycles down to intervals of even a few years, second, pollen analysis, which deals with weather in cycles of centrelling the process of th

The first method is relatively wellknown, and much information has been accumulated through correlating climatic variations with width of annual growth rings in trees Periodicity of wet and dry weather has been established and, in conjunction with local weather bureau records, it can be discovered that either a wet or dry cycle is commencing. The first few years are critical in the life of forest plantations, and absence of moisture is most often the fatal factor. In forest planting, especially, short-range determination of the weather cycle is an invaluable aid because it is possible to choose years at the beginning of a wet cycle and plant accordingly

The second method of long range forecasting, pollen analysis, sit ill new, relatively unknown, and not as well substantiated as tree-ring analysis. However, it does hold promise of additioning to our knowledge of changing climatic conditions and it does have significance in forestry. It is obviously more intelligent to handle existing forests other they will perpetuate them:

Forest Managers Beginning to Use a Method of Long-range Climatic Prediction . . . Based on the Study of Fossil Pollen Grains with Microscopes

By W. F. McCULLOCH

selves than it is to clear off forests in the lumbering process and then start from scratch with seedlings From the long-range standpoint foresters wish to know whether or not forest species will maintain themselves naturally or whether they will die out under natural conditions, necessitating replacement with different species Information on the possibilities of continued growth of a species in a given region may be calculated by determining whether its pollen is increasing or decreasing in peat bogs. This process of examining peat profiles in bogs to determine their pollen content is now known as pollen analvais Because of the potential value of this kind of investiga tion it is described here in some detail

Until lately it was thought that fossils in rock and coal

seams were our only record of forests of the past, but recent studies in Europe and in North America have disclosed a fascinating source of material which enables the reconstruction of forest history since the retreat of the glaciers Different plant groups may be identified by their pollen, and the dominance of different types of plants, as shown by the excess of their fossil pollen in peat bogs, indicates a type of climate known to be hospitable to those plant groups For example, gradual replacement of fir and spruce pollen by hardwood pollen indicates a period of increasing warmth in the long-time weather cycle; indicates also that southern trees may safely be introduced farther north. For those who are able to read them, such peat bog records of our forests are scattered all over the northern part of the continent

THESE records are intimately tied up with the glaciers. As the ice melted and glaciers retreated, forests moved up from the south to take over the newly uncovered lands. The ice



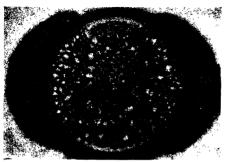
Courtesy New York State Museum
A vertical section of varved clay from the
bed of a former glacial lake in New York
State. One-inch squares at left give scale
These thin, annual, horizontal bands of vary
ing sediment enable the geologist to work
out definite dates which, in some casean be correlated with hop pollen dating

pack was by no means uniform, and many small depressions were left on the uncovered terrain. These low spots filled with water from the melting glacial front, and, with the advance of plant growth, box formation began

The principal plant in a log is sphagnum moss. As it decays, plant fragments sink to the bottom of the pond gradually filling it. As more and more plant remains sink down, the moss becomes a more or less homogeneous layer of organic material—peat

With no draining from the bog, the standing water over the peal becomes acidic. The constant addition of decay ing organic substance soon raises the acidity to a point where decay organism are either greatly hampered or cannot function at all. Materials falling into the bog are therefore preserved practically unchanged in the peat. Pollen 16 noe of these materials

It is not uncommon to find lakes covered with a yellow dust in the spring or, at the same time, to find a yellow ring around mud puddles. Upon examination this will prove to be pollen — tree



A winged pollen grain of Austrian pine, magnified approximately 1450 diameters, a probably unexcelled photomicrograph by Dr F P McWhorter, of Oregon State College The retruduations on the surface of the wings afforded identification

pollen, most of it. Almost all trees are award pollmated, they do not have showy wind pollmated, they do not have showy wind pollmated to a tract bees and hence they go depend upon the wind of advisible them. This is a somewhat haphazard method. Therefore, in order to assure method. Therefore, in order to assure itertilization of the female flowers, immense quantituses of pollen are produced on the falls into bogs and, as bog of the falls with bogs and, as bog formation continues succeeding layers considerable to the produced of pollen are incorporated into successive layers of peal

Pecularly enough, pollen, though seemingly a fragile substance, possesses makes possesses makes possesses makes possesses to the possesses the po

ANALYSIS of a vertical series of samples from pollen-containing peat makes it possible to trace the history of the succession of different kinds of trees composing the neighboring for ests from the time when the bog was established Conferous pollen is mostly equipped with wings, as shown in the illustration, and some investigators have assumed that it will travel farther than the non-winged pollen of non-coniferous species. However, the very fact that forest pollen is so widely transported by wind is adequate assurance that the record will be representative of trees over a wide area, not merely of those adjacent to any given bog. The author has found pollen floating in sea water 75 miles offshore from a forest of Sitka spruce and hemlock, and pollen has been trapped on glass slides exposed on airplane wings at an altitude of 10,000 feet.

A very fine correlation has been worked out in Europe between peat bog histories and clay varyes, another form of geologic record Clay varves, shown in the other illustration, are the sedi mental bands of water-borne silt laid down year after year. The coarser material brought down by the spring flood water alternates with bands of finer silt laid down by the quieter water of mid summer, and thus provides an annual record Varves may be counted back about 25,000 years, which is roughly the length of our pollen deposit history Investigators in Europe have discovered for example, that at the geologic period when birch remnants were common in the varyes there was an abundance of birch pollen in the peat deposits of the same period Similarly, finding spruce or other conifer twigs and leaves in the varyes would be correlated with finding pollen of that species in peat layers of the same age. This is the strongest evidence of the authenticity of peat bog

The mechanics of pollen analysis are simple Samples of peat from successive layers are obtained by means of a peat as sampler. This is a short section of pipe equipped with a cap at one end. The eap is attached to a steel rod running through the pipe, and threaded so that any number of rods may be coupled on. The sampler is pushed down into the peat to the desired depth, then the rod is pulled up gently, drawing the cap back into the pipe where a spring engages it. The sharpened lower edge of the pipe is thus exposed and as it is once more pushed down, a core of peat is cut off and retained in the pipe

Separation of pollen grains from the peat may be accomplished by adding chemicals which destroy the peat and leave the pollen grains fairly well in tact. Another method, used by the author, is to separate the materials with an ordinary milk-shake muser. After thorough agritation the various particles may be separated by adding a water-soluble due such as safranin. This colors the peat pink, and leaves the pollen grains their natural brownish or yellow color, greatly facilitating dentification.

A drop of peat material is placed on a microscope slide and the grains are tallied in order of occurrence. Only a few different kinds appear in the record at one time, and it is not necessary to count a great many at each level in the bog in order to establish a truly representative sample of the pollen present

When samples have been obtained at one-foot intervals down to the bottom of the bog it is fairly easy to reconstruct the history of plant succession in that region. The replacement of tree pollen by grass pollen in some bogs, followed again by an abundance of tree pollen. indicates that over a long period there was sufficient change in climate to elim mate trees and replace them with vege tation of prairie like character Return of the trees may be interpreted to mean return of moister weather cycles This is the important phase of pollen analysis to foresters. It gives at least an indication of the kind of weather to be ex nected for the next few hundred years. and therefore an indication of the kinds of forests which may be expected to maintain themselves in the region during that period.

XAMINATION of a bog north of E Syracuse, New York, showed balsam fir and spruce to be the most numer ous pollen at the bottom of the bog These two species gradually gave way to beech, oak, and white pine Similar conditions have been found by other investigators working in Ohio and the southern Lake States, in all cases a solidly coniferous forest followed the retreat of the glaciers Hardwoods came in from the south, at first slowly, then in increasing numbers, until they dominated the forest. This is the condition existing today Hardwoods grow more rapidly as young trees and, starting from seed, will generally grow fast enough to shade out associated conifers From the evidence of pollen analysis, hard woods may be expected to be a safe bet for forest production in the northern United States for several hundred years After that time it may be necessary to anticipate return of the conifers. Analysis of the pollen profiles that are being laid down in peat bogs today will tell the tale

WHAT CAUSES MAGNETIC STORMS?

WUCH public interest has lately been aroused by the occurrence of "magnetic storms" Along with variations in the Earth's magnetic field (which, by themselves, would have been noticed only by the possessors of delicate recording apparatus), great solid crust of our planet Points a few hundred miles apart were at electric potentials differing by hundreds of volts - which became almost dangerously evident when a continuous tele graph wire joined them. The "earth currents" spilled over into telegraph lines and completely disorganized the operation of the intricate - and usually perfectly functioning - automatic recording instruments used in modern telegraph practice. Radio reception was badly disturbed, too, showing that the trouble extended far up into the upper reaches of the air, to the ionized and electrically conducting layers which normally act like a smooth concave reflector, and divert radio waves around the Earth All North America, and communications with Europe, were affected. and, judging by previous experience, the effects were world-wide

The first thing that those who knew anything about the subject asked astronomers was "Where are the sunspots which are responsible?"

This was no idle question. For half a century and more the Earth's magnetic field has been carefully recorded by automatic apparatus at many stations Great numbers of magnetic storms have been observed - only occasionally as large as those which recently happened - and it has been found, year by year and decade by decade, that their numbers rise and fall in striking parallelism with those of the spots upon the Sun, in a manner which leaves no possible doubt that the two are in some way closely connected What is more, it is usual, at the time of a great magnetic storm, to find a group of sun spots near the center of the Sun's disk -though this is not a rule without excep-

In the same system of related pine momens belong the great deplays of the autora — the Northern Lights — which extend south from the Arctic regions to the middle latitudes, and, rare-ly, even into the tropics. These are practically always accompanied by pronounced magnetic disturbances, and are related in the same way to sunspots.

The evidence was convincing, even 40

Not Sun-Spots but Gases Erupted from the Sun and Traveling to Earth at Times of Solar Turmoil . . . Sun-Spots May but Need Not Accompany This

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson

years ago, that these were all intimately related — not by accident, but by some real causal connection. But the interpretation of this connection still leads to some of the most puzzling problems of comincal physics.

In the first place - which is cause and which is effect? The luminosity of the aurora and the disturbances of radio transmission occur simultaneously in the same part of the upper atmosphere, and evidently are two sides of the same event But do the currents made the Earth cause those in the atmosphere, or vice versa? This question can be handled mathematically. If the disturbing magnetic forces which are superposed on the ordinary steady magnetic field, and their changes with time, have been so well observed that we can get a good idea how they changed all over the Earth, an analytical discussion based on principles worked out by Gauss more than a century ago will show whether the currents which produced these forces were inside or outside the Earth's surface (on which the points of observation lay). The answer is definite - the main source of disturbance is outside. Hence the currents which flow far above our heads are primary, and those within the Earth are secondary - induced by the others

BUT what is the relation of all this to sun-spots' Common sense suggests that things happening in the thinnest part of the airy envelope of our little planet can hardly be the causes of the appearance of spots on the Sun, 93,000.
Old miles away, and so large that the Earth could be dropped into the middle of the dark center of one and have a rim around it thousands of miles wide 'Yet how can these soots affect the Earth'

Cumulative evidence has convinced everyone that the spots are not effective in themselves, but that they serve as a useful—and decidedly accurate—index of the varying general activity of the Sun Near an actively changing spot, the Sun's surface is in turmoil. Bright regions, as well as dark, often

appear, and, when these are seen at the edge of the vasble hemisphere, eruptive prominences are frequently observed Great masses of gas are raised high above the ordinary level of the chrome-sphere, and subject to rapid and extraordinary changes The admirable motion pictures obtained by Lyot in France and Modkath in Michigan show that the motions are very complicated Often the luminous gas which goes up comes down again, but there are times when great masses of it are reducibly driven clean away into space, at huge and increasing velocity

If we follow such a mass of gas -say hydrogen - in imagination, we must conclude that, as it becomes excessively rarefied, it will be ionized the electrons will cut loose from the protons Such a swarm of electrified particles can no longer give out the familiar spectral lines, and will be invisible But the attraction between the positive and negative charges will keep it from spreading out indefinitely Suppose that such clouds of particles, flying away from the Sun at perhaps a thousand miles per second, should pass the Earth Even a small magnetic field - like that of the Earth 50,000 miles away - has an extraordinary influence on the motions of charged atoms (and much more on electrons). They no longer move in straight lines, but at first in sweeping curves, then, as the magnetic field increases, their tracks become spirals around the lines of magneuc force By the time they are a thousand miles from the Earth, they will be practically coming down these lines of force - though in narrow spirals and will enter the Earth's upper atmosphere, mainly in the vicinity of the magnetic poles They will naturally set the thin gases shining -- as artificially produced streams of electrons do in vacuum tubes - will come on down until their energy is exhausted, and then stop. This accounts in a general way for the properties of the aurora - its appearance in the polar regions and the fact that the luminous clouds or

streamers rarely come lower than 60 miles above the ground, and never lower than 45. Separate patches and streaks in the cloud of particles account for the ever-changing clouds and streamers of an active aurora

It is obvious, too, that the incursion of this swarm of charged particles into the atmosphere will ionize it — affecting radio transmission — and make it more conducting, so that considerable electrical and magnetic effects might follow.

W/HEN investigators pass from these qualitative considerations to a detailed attempt to explain the great and apparently erratic changes of field in a typical magnetic storm, the thing becomes very complicated, and no satisfactory detailed solution has yet been reached. The elementary theory indicates that the region where most of the particles come down should be but a couple of hundred miles from the magnetic pole, instead of 1500 as it is. The system of currents which produce the magnetic storm may account for this, but no one knows quite how. It is also not easy to see how a swarm of particles which has come 90,000,000 miles can contain denser patches as sharply de-fined as would be required to produce the narrow straight rays which so often appear in the aurora. But this seems to be no reason for giving up an explanation which is so satisfactory on general lines

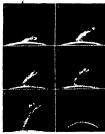
The regions of eruption on the Sun, from which the clouds are ejected, are usually, but not always, connected with spots - which explains without difficulty why the same is true of magnetic storms and aurorae on Earth An additional effect, of a different type, has recently been well established. At various times, brilliant eruptions have been seen upon the Sun's surface, usually near spots. Far the brightest of all is one recorded by Carrington in 1859. He was making his daily drawing of the sun-spots visible on the disk when two patches of intensely white light suddenly broke out in the vicinity of a large spot group. Within a minute this had begun to fade, and a few minutes later they had vanished entirely.

Up to the present, no similar eruption, bright enough to be seen in integrated sunlight, has yet been recorded, but there are plenty of them which can be observed with the light of a suntable spectral line — preferably the red line of hydrogen

In 1935 Dellinger pointed out that high-frequency wireless transmission had exhibited several sudden "fade-outs," involving great areas, but always on the sunlit side of the Earth, and suggested that they might be connected with solar eruptions. By good fortune, spectroheliograms had been taken at

various observatories at the very times that some of these fade-outs occurred, and these showed that eruptions had actually happened.

On April 8, 1936 a very brilliant eruption was independently observed at Mount Wilson and in Peru, and disturbances in the ionosphere and the Earth's magnetic field were recorded at the same moment. This crucial observa-



A series of six spectroheliograms covering a period of 75 minutes and showing some of the extraordinary changes seen in eruptive prominences as mentioned by the author. The six views are frames from a continuity of about 500, made by McMath and Sawyer with the new tower telescope at the Lake Angelus station of the University of Michigan The prominence lifts slowly at first accelerates rapidly, reaches 500. 000 miles above the Sun in frame E, then rushes into space at an exceed ingly high velocity. In the Lyot co ronagraph films one observes similar action—the prominence seems fairly to slip off into space and vanish in apparent nothingness. The effect on the viewer is one of awe

tion has been confirmed on various subsequent occasions, and there is no doubt that these hight solar emptions are accompanied by fade-outs in short-wave wireless signals, and by certain small but definite magnetic disturbances quite unlike those of an ordinary magsite storm.

Since these phenomena occur at the very moment the eruption is seen, they must be produced by something which has traveled from the Sun to the Earth with the velocity of light — that is, by some kind of light itself. Visible light would not affect the upper atmosphere perceptibly; but a burst of ultra-wolet light, of weelength too short to get down through the air to the Earth's surface, would by that very token do something in the upper regions where it was absorbed. The changes which affect radio transmission take place in the D layer of the tonosphere, at an eleva-

tion of about 60 miles. Very abort-wase light, like the strongest line of helium at 3594, would be absorbed by the upper layers, and not get down so far. But the great hydrogen line at 1215 — which is undoubtedly enormously the strongest line in its spectrum — would penetrate to about the right depth, and, when finally absorbed, increase the nozization finally absorbed, increase the nozization

K NOWLEDGE of the spectra of these cruptions is therefore important, but it is hard to come by Richardson and Minkowski — who have made successful observations at Mount Wilson—say, "The observer is in a position somewhat similar to that of a man trying to photograph the corona without knowing when an eclipse will occur."

He must watch continuously, and have his instruments ready for instant

Working with the smaller tower telescope, these devoted observers watched the Sun vsually with a spectro-helioscope, and, when an eruption occurred, and everything in readiness to photograph the spectrum instantly, on motion picture film, or, for the infra-red, on plates loaded in a special magazine Between July and December, 1938, close to the time of sun-spot maximum, they recorded numerous small eruptions, but only five of the higher grades of intensity 2 and 3.

The visible hydrogen lines show bright in these eruptions, and are the most conspicuous feature of the spectrum. The calcium lines H and K which are bright anyhow near sun-spots, appear in the eruptions, and in one specially bright eruption the infra-red line of helium, at 10830, showed bright.

This indicates clearly that these eruptions are primarily regions of strong emission from hydrogen, with probably helium too in the stronger ones Now, by the very nature of hydrogen, an atom which has emitted one of the visible lines will go on to emit the great ultraviolet line Could we get outside our atmosphere and photograph with this line, there is no doubt that the erup tions would appear as enormously bright spots on the surface of the Sun which shines feebly in these short wave lengths Working, as we do, at the enormous disadvantage of having to ob serve with the relatively weak lines in the visible region, we must catch only the greatest eruptions, which give ou such a flood of ultra-violet light tha they influence our atmosphere, far away

Light of this intense hydrogen line; i very powerfully absorbed by hydrogen atoms, and hence exerts a strong radis ion pressure upon them. It is furposhable that the pressure of radiatio from ultra-violet bright spots, not so notable on the major eruptions, bear a large part in driving the eruptiv prominences away from the Sun

TANTALUM—NEW OLD METAL

If one is acquainted with the latest in chemical plant equipment, in electronic tube construction, or the science of metal-cutting and wire-drawing, tantalum is no mystery. But to many it is just a name. From now on, however, it is something to watch as a metal having great practical value.

Tantalum is a new, old metal. It is old because first noticed about a century and a half ago, although a hundred years had to elapse before it was isolated. It is new because it joined the community of commercial metals only 18 years ago, and that's yesterday in metallurgical time In those 18 years, research had to cover a lot of territory Methods had to be devised for producing tantalum on a commercial scale, physical and chemical properties had to be determined, ways and means for manipulation and control had to be perfected, and not until all this was accomplished did a curiosity become a practical tool of production

If you think this a long time in which to get from the unknown to the known, you fail to appreciate the peculiarities of tantalum. The metal cannot be extracted from its ores by orthodox smelling or reducing methods. A chemical process is required. Nor can it be put not useful form by any simple process. The pure salts have to be reduced to provide the many control of the provided metal, which is then pressed and sintered in vacuum furnaces. When this much has been accomplished, special techniques must be used to weld, red for the provided metal of the provided meta

The outstanding properties which recommend tailuin to the commercial world are a remarkable resistance to corrosion and themeal attack, in which quality it surpasses virtually all other metals and allow, an ability to absorb and retain gases at high remperatures in the vacuum, the precluracy of forming anodie films of unusual stability, and a strength cummarable with state.

The first commercial use of tantalum was in batters-charging rectifiers where its film-forming characteristic was capitalized upon. Shortly thereafter came anodes, grids, and other parts of electronic tubes. Its ment for these latter applications is unquestioned, but its position is challenged continually by less expensive substitutes.

Tantalum is having its greatest success in chemical plant equipment. Since most organic acids salts, gases, alcohols ketones, aldehydes, and esters leave tantalum unaffected, and the high strength of the metal permits the use of thin walled tubes and sheet, even when high

Unsurpassed in Many Uses, Especially Chemical Equipment... Has Passivity of Glass, Strength of Steel... Hard Tools Made by Powder Metallurgy

By PHILIP H. SMITH

pressures are to be used in processes, the chemical industry now has a material which couples the passivity of glass or craimics with the strength of steel. Tan talum, therefore, is coming to be used in heat transfer equipment and in acid manufacture and recovery systems.

Many chemical processes use reagents which are extremely corrosive to almost soft all metals. Class, ceramics and some-times plastice can usually be used for for times plastice can usually be used for the kettles, tanks or piping, but since these some other times plastice, some other times plastice, some other times to the control of the corrosive fluids. For heating, one other times to distribute the cooling, and condensing operations, tanituding is not only insert to themical attack, but each square foot of the metal alm is not only insert to the metal almost a much heat as 15 or more responsible feet of the container material, or anything else which could be used.

COMPACT, highly efficient, hydrochloric arid absorption systems, fashioned of tantalium are now replacing older, cumbersome systems. The new type does not require an isolated building to house it, because there are no excepting fumes to attack surrounding structures. When murratic acid is produced as a by-product of a chlorinating process, full recovery of the acid can be and and this by-product made to syled a profit. In view of the ever-increasing importance of the chlorine compounds to the chemical industry, the use of tanratium equipment is certain to expand

Before tantalum's mertness to acide could be given the practical twist there had to be long research into problems of fabrication. This could not be done overnight. Heating and condensing units require the material in tube form and tantalum could be neither drawn nor welded dies at tended to seize to the steel and ulbricants were meffective. Now tantalum, in carbide form, used as a die material serves the purpose.

The welding point of tantalum is about 6000 degrees Fahrenheit. If it is heated in air, it will burn at 2000 degrees Fahrenheit. To make welding practical required a method whereby the metal could be protected while undergoing the pro-

cess. Furthermore, if the corrosons-resistant property of tantalum was to remain unimpaired, the welding union had to be made without solder. Today, tan talum can be welded to itself and to a number of other metals by electric spot, each, but and roller processes, but not be torch welding. The operation is carried on under a liquid surface, with special techniques devised for both seam and are welding.

The early days of radio gave tantalum. In a commercial momentum Battery radio sets demanded rectifiers for the conversion of alternating current into direct current for charging batteries. Here, tantalum serves particularly well because of its unique electrolytic "calve" properties. When tantalum is used in an electrolytic cell with a dissimilar metal, such as lead, the flow of current forms a stable oxide film upon the surface of the tantalum. This film conducts current freely from the electrolyte to the tantalum. But not in the opposite direction,



Tubes of tantalum in absorption tower resist corresive action of acid

hence converting an alternating current into a direct one Rectifiers employing tantalum are used in railway signal service, telephone switchboards, and fire alarm systems

It is told that perfecting the tantalum rectifier came about through a fluke When experimenting with a number of cells to determine why it was that current flow fluctuated so violently, one cell displayed the desired eveniness. There was no scientific explanation for this until it was discovered that a tack had dropped into the electrolyte, and thus the addition of an impurity—iron—provided the stabilizing medium which put tantalum into the foreground. Even to-day, signal maintainers, when cleaning a tantalum rectifier cell, sometimes dis-

Tantalum electrolytic condensers are the most highly efficient made, and the fact that they are self healing puts them further in a class by themselves. When first made it was practice to take a sheet of pure tantalum, shot blast it to me rease surface area and then crumple it into condensed form. Present method uses



Photos Fantel Metallurical Corp Porous tantalum elements for electrolytic condensers are "self-healing" If the condenser is broken down by over-voltage, film re-forms

the art of powder metallurgy in that powdered tantalum is compressed into a porous element. This gives a capacity per gram five times that of its predecessor. Furthermore, if the element is punctured by a high voltage, such as stroke of lightning, it heals itself and goes on working. The porous type is cheaper to produce because manufacture begins with the powder and thereby skips ingot and sheet stages of production. It is suggested that the greatest use for these elements will be found in the communications field, but they can be employed in many others.

Thus far tantalum has been considered as a pure element, but the contribution to industry is by no means limited to the metal in this state. Tantalum carbide, a sintered product, and tantung, a cast one, are both serving the metal-forming industries, but just what they are and why they are being used for tools, dies, and wear-reastant parts requires going back a moment for auxiliary information.

SOME USES OF TANTALUM, ITS
ALLOYS, OXIDES, AND
COMMINATIONS
Electronic Tube Elements
Dies, Tools, Tuber, Rods
Rectifiers
Chemical Equipment
Acid Absorption Systems
Welding Rods
Electropitic Condensers

Agitators, Spinnerets



Edges of cutting tools Use forms a crater on tungsten carbide tool at left, not on tantalum carbide, right Broadly speaking, there are three

classifications of metal-forming tools Arranged in an accending scale of red hardness, these groups are High speed steels

High speed steels Cobalt-chromium tungsten combina

Cemented carbides

tions

There are many varieties within each group and years of experience have pretty much fitted the tool to the job When cemented carbides came on the market, tungsien carbide was hailed as an ideal tool for euting steel, but it failed in its promise It was extremely hard and would cut at high peeds, but it sufficred from the phenomenon of cratering, or the tendency for a tool to wear away where the chip strikes as it leaves the cutting edge.

Tantalum carbide displays a marked resistance to cratering and when added to the other refractory carbides produced the first really suitable tool for maching steel. Tantalum carbide has a wetting or self-lubricating property which presumably explains its achievement.

Tantung is an alloy consisting of fine particles of ungates and tantalum carbides imbedded in a matrix of chromium and cobalt, and is distinguished from carbide compositions by being cast rather than sintered It lacks the ultra hardness of the carbide group, but is tougher, hence it fills a rather wide gap between the cobalt-chromium-tungsten group and the carbides.

The role selected for this new material to play is the cutting of steel, particularly for interrupted operations where a certain amount of shock must be taken and which would be likely to break down the more brittle carbides in actual cutting operations it can take larger bites because of its toughness, but not at a bush arrord as its carbides.

but not at as high speeds as the carbides The fact that tantung is cast rather than sintered is significant. It suggests that tantung is more easily handled than carbides, and this is true in some particulars The sintered carbides must be formed in soft state and then hardened to unalterable form, tantung can be given other shapes by welding. The extreme hardness, characteristic of carbides can be imparted to surfaces to make them highly wear-resistant, by the simple expedient of laying down a tantung denout with a welding torch. Thus an almost unlimited field of usefulness is opened

TANTALUM carbide is used in diese for much the same reason that it goes into cutting tools. Its hardness and weiting properties in the form of carbides give it special value. Tanting enters into die construction because it displays a great resistance to deformation under heat. It is used for large size dies, for heading and suring dies, for certain extrusion types, and in general wherever high pressures and shock must be stood

Tantalum is a high strength metal, as otherwise it would be impossible for otherwise it would be impossible for tubes of it having walls no thicker than the total times of the having walls no thicker than the stand pressures as great as 150 pounds per square not Since chemical attacked does not occur under conditions where conditions where commended, it is unnecessary to provide for loss of metal due to corrosion, as its commonly done when hase metals are used. Therefore, thin walled tubes are safe at high pressures

Strength and non-corrosive properties up to tantalum into many applications. Thus we find agitators in mixing equipment being given faintalum-covered steel shafts and solid natalum blades; acrators which have tubes and jets of the metal, and tantalum protected pump shafts and valves. Spinning jets used in viscoee process rayon manufacture have been made of tantalum, but these are used principally in countries where the shortage of precious metals offsets the low scran receiver value of traitalum.

Just what territory tantalism may next preempt is any man's guess. Those who have worked most closely with it are loath to make prediction. It takes long and painstaking research to prepare the ground for small advance and there's still much to learn about this unusual metal. One can guess that whatever is mow will utilize the unique properties already employed and which are not duplicated in any other metal or allow. This would give tantalism more value and prominence in the industrial scheme

WHAT IS DEATH?

AFTER he is dead, can a man be brought back to life? Can a man de twice?

On an operating table lies a patient, already askep under the influence of the anesthetic. A most delicate operation is imperative, to save the man's life, though he has been weakened seriously by a long illness A slowly but steadily growing tumor has for months been exerting pressure on his brain.

It is dangerous to use the knife on so weak a patient Yet it is dangerous to postpone the operation. The cancerous growth must be removed by surgery Otherwise the tumor will in a few weeks be pressing on vital centers in the brain, and then suddenly the man will die.

The surgeon gets busy with his gleaming sealpel? The patient's pulse is under constant observation it is very weak Gradually it becomes still weaker. The anesithetic and the shock of the surgical kinfe prove too much for the strained heart. The nurse taking the patient's pulse warns the surgeon. Then, all at once, the heart-thripobling flutters out en turely. Instantly, the surgeon halls his cutting, and calls for the hypodermic needle kept ready at hand for just this emergency.

The hypodermic contains a solution of that most powerful stimulant, adrent in Calmy the surgeon takes the needle from the nurse finds the proper point immediately over the heart, and firmly presses the needle through the skin and itsuse — straight through and into the very heart muscle, now completely still. Adrealin solution is injected into the heart tissue. The patient's heart has not been hearting for several seconds.

ONLY a few years ago, before the discovery of the use of adrenalm, the man would have been pronounced dead But the adrenalm accomplishes a seeming miracle. Almost immediately after the injection, the apparently dead heart commences to throb again - very faintly, almost imperceptibly at first Then the pulse becomes stronger and stronger Amazingly, the normal heart beat is restored. The patient has been snatched from death. The surgeon can proceed The removal of the tumor is accomplished successfully The dangerous, almost fatal operation completed the still benumbed patient is carried to his bed. His convalescence is necessarily very slow, but he finally makes an uneventful recovery

Now, when the newspapers report such a remarkable life-saving feat, as in Science May Know When it Learns What Life Is... No Surgeon Ever Brought a Dead Patient Back to Life... We Do Not Die All Over, All at Once

By BARCLAY MOON NEWMAN

this case where adrenalm is used to restore the contractions of a seemingly dead heart, as a rule they say that the surgeon "Strings a dead man back to life." Sometimes the patient is interviewed— after he has recovered sufficiently— and asked for his sensations while "dead." Werd sensations may be described, or the patient may say that he felt nothing.

What is the truth? Was the patient really dead when his heart ceased to throb? The truth is that no dead man has ever been restored to life. That is, death involves more than a mere, momentary



Nerve cells of an infant dying at birth and of a man whose death was attributed to "old age" Loading up with granules may kill the cells

halting of the heart beat. In fact, medical records list the cases of several persons who have had the extraordinary power to make the heart stop beating for minutes at a time The individual would, when he voluntarily caused his heart to suspend its action, become un conscious. Then, after a brief period, his heart would start beating once more, and his consciousness would return. The most famous of these persons with varying degrees of control over the heart died recently - at an early age, follow ing a severe heart attack which occurred a few days after he had made an astounding demonstration of voluntary heart control before a gathering of physicians

Hence it is evident that death is more than temporary stoppage of the heart's contractions. In the case of the patient whose heart fails during an operation only to have heart activity restored by adrenalin, the life-giving flow of blood pauses for only a very few seconds. When the heart starts beating again, immediately fresh blood, carrying the needed food and oxygen, courses through the arteries and other blood vessels of all the tissues, especially the most delicate tissues, those of the brain. The microscope units, or cells, have merely been forced to reduce their vital activity to a minimum. Few, if any, tiny cells periah at such a time, even in the brain

NOR are the patient's heart cells less active than usual, their functioning reduced by want of nutrents and oxygen, by accumulating wastes, and by accumulating wastes, and by accumulating wastes, and by accumulating mere centers of control. They are alive, but not active enough-having insufficient food and oxygen—to make the powerful contractions necessary to the beating of the heart As asson contract, make the blood recommence flowing, and thus supply themselves and flowing, and thus supply themselves and the other tissues with required substances, so that quite active life can be maintained.

If the blood supply is cut off for more than a very few minutes, many of the microscopic units, or cells, of the tissues actually die And if even small portions of vital tissues are killed, they drag the remainder of the body down into the abvsm of true death, from which there is no excause—and never has been.

Brain cells are most rapidly killed. Other cells, after the supply of needed materials is shut off, die less speedly. Cells of internal organs, such as the liver or kudneys, may stay alive for hours, sometimes even for weeks. Cells of the intestine seem to be most hardy, and have been found alive more than two weeks following the death of the rest of the hody.

Bodies, then, do not "die all over, all at once." In the light of the fact, what is death." Though the meaning of the term death as, strictly speaking, never altogether definite or clear, every day thousands of individuals are pronounced legally dead—and quite rightly so—because the heart beat cannot be restored after a reasonable clapse of time, and breathing also has evidently been halbed without any chance of being restored. Further, of course, the body's tissues

within a few hours become completely cold, and stiff—as rigor mortis sets in.

Nevertheless, days after an individual is legally deed—and perhaps burned—fragments of the mner organs could be found fully alive The tmy harrs in the undippe which sweep dust particles upward and away from the lungs during life, are frequently found still exhibiting thieir rhythmical sweeping motion—their rhythmic beating This proves that the issuess inside the windpipe are still the individual still the still the still prove the still representations.

Such living portions of dead bodies may be cut out and placed in glass flasks containing solutions of food and oxygen Kent warm, and in the midst of this food and oxygen, and with contamination by microbes carefully prevented, these bits of tissues may be kept alive in the laboratory indefinitely Moreover, at the Rocke feller Institute, methods of stimulating these hving fragments have recently been discovered, and as a result these bits of tissue can be made to grow Yet the growth is aimless, and never results in the production of a whole new organ or even anything more than a still micro scopic piece of formless tissue. It would be possible for a wealthy man to provide for the keeping alive of whole sections of his body, following his death ("legal death") - though these sections would have to be kept alive as numerous separate and very tiny bits, each in an individual flask holding food and supplied with oxygen Such test tube life, it is thought, can be maintained indeh nitely - probably for centuries - pro vided it is suitably cared for by con tinually supplying fresh nutrients and fresh oxygen, and transfering the bits of tissue to fresh flasks once or twice a week

Tissues of continuous. pecially very low forms of life -- for example, many kinds of worms-are far more bardy than those of warm-blooded animals, such as mammals and birds. In the 18th Century, a biologist named Baker obtained some threadworms-microscopic worms having a threadlike appearance-after learning that these worms had been kept quite dry and seemingly quite lifeless for 27 years. After they were soaked in water, they began to revive, and soon were swimming actively in the water. This experiment is said to hold the record for suspended animation among animals Plant seeds. however, may be kept even longer in a state of suspended activity, and then made to aprout when planted Spores of molds and bacteria are believed capable of indefinite existence in dry, cool places -perhaps for thousands of years, though experiments showing the presence of living spores sealed for thousands of years, if not millions of years, in lumps of coal, are not generally accepted by

a majority of conservative scientists. There is no scientific test for death. Indeed, the most expert life scientist cannot tell whether a dry seed as dead or merely dormant until he has observed the seed over a lengthy period to see whether moisture and warmth cause the seed to start sprouting. Thousands of scientists through the centuries have sought for a simple test for death. Today it is commonly believed by biologists and medical experimenters that there never will be a simple death test—at my rate, not until that far-off day when





continuous unider winch death of the continuous different types of living things. Above, A spore of living things. Above, A spore of living things. Above, A spore of living things, Above, A spore of living the collection of the continuous accordance with the collection of the colle

the secret of life is discovered. For, death is merely the stopping of the life processes, many of which escape notice and all of which are utterly mysterious

Since there is no death test, frequently errors are made in the attempt to de termine whether or not a person is dead The heart action and the breathing may be so faint as to clude all efforts at de tection, and meanwhile the body may grow fairly cold. Evidences there are aplenty that individuals pronounced dead have been buried alive by mistake Thus, tombs have been opened and found disturbed within, just as though the buried person had regained conscious. ness and struggled to free himself. And of course at least some of the stories of a "dead" man suddenly sitting bolt upright on the undertaker's table are true

Nevertheless, though there is no simple scientific test for death, scientists are quite cortain that affer the heart has definitely ceased beating during more than 10 or 15 minutes, a human being is dead beyond the shadow of a doubt The problem is, however, to be sure that the heart has actually ceased its throbbing.

In cases where a person is nearly drowned, and is revived only after per-

haps in hour of artificial respiration, the heart cannot have halted completely for more than a very few minutes, if it has halted at all Very faint heart action can any proceed without ready detection. Should halted the heart have stopped for a full ten minutes, resuscitation means that the individual is reviewed in spite of the definite and urrevocable death of many cells of the fragile brain—and the individuals is thereafter demented, though he may live out his normal span of the

RECENT experiments with dogs supelbauer, bled dogs until the most refined electrical tests showed that the pumping action of the heart must have been completely stopped If he waited not more than five or six minutes, and then quickly returned the blood to the animal by transfusion, a few of the dogs would recover. If he waited even two or three minutes longer, practically none of the animals could be resuscitated-though occasionally a dog could be brought back to life after as long as 20 minutes. (By "bringing back to life" is meant restoration of the full activity of cells whose activity has been brought to a low point by lack of oxygen-but whose activity has definitely not been terminated, even for a moment, by actual death.)

In mataness where electrical recordings have been taken of the falling heart against a cition of dying men, it has been found that electrical signs of a slight pumping action may persist for sometimes 20 minutes after recipration has seemingly been completely stopped and after they uptake has completely stopped and after they married the seeming the se

In view of such findings, it is evident that many a drowning person may have slight heart action, though breathing has been stopped and the pulse has disappeared Clearly, the person is not dead. But not only in cases of drowning but also in all other cases, when the heart's pumping has been stopped completely-brought to a dead standstill then, usually after five to ten minutes and certainly after 20 minutes, all hope of resuscitation is gone For, after these few minutes of lack of oxyger, and nutrients, whole areas of the brain cease all life activity-that is, perish. And once dead, a cell or a tissue or an organ 18 "dead all over," and dead beyond recall

A dead man cannot be restored to hife A human being cannot die twice.

It is clear that a knowledge of what death is must await the discovery of the secret of life. Meanwhile, scientists, while zealously hunting the mystery of life, must define death as the opposite of life—the absence of that world of activities which mean life.

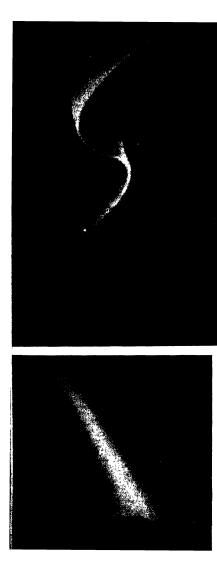




Figure 1 Left An aurora of the S-curved curtain type, observed in Illinois in March Figure 2. Above Coronal type of aurora observed at Bar Harbor, Maine, in August

Marvels of

By WILLIAM CROWDER

SPECTACLES of such transcendent beauty as the aurora polaris, the parselenic rings and arcs surrounding the Moon, and the zodiacal light, are beheld more frequently in North American skies than is commonly believed

Contrary to a widespread belief, the aurora may occur at any season of the year, not merely in winter. The phenomenon referred to in the northern hemisphere as the aurora boreals is the same thing which is called the aurora australis in the southern hemisphere, the term aurora polaris, or simply aurora, applies in general to both

There are several type-forms of the aurora, a common type being the exquisitely colored, tenuous, folded curtain form shown in Figure 1 and in the upper portion of Figure 5. The commonest form of all, however, is the arch, shown in the lower part of Figure 5. The arch may be without color, a pearly kind of light, but more often it exhibits several delicate primatic colors. A times it may become truly agreeous Though the position of the arch itself may remain comparatively fixed, its parts may pulsuate Sometimes it may send upward needle-like streamers varying in length and brilliancy. More rare with coronal rupe of aurora (Figure 2),

More rare is the coronal type of aurora (Figure 2), conceded by most observers to be the most impressed of all auroral forms. It is seen almost invariably at or near the zenith, and it presents the aspect of numerous faniske rays emanating from a common center.

When color is present in the different auroral forms, it is most usually apple-green. Although nearly all colors may be seen, those next in frequency are rose, red. lavender, violet and deep purple.

Discoveries about the northern lights have completely

Figure 4 Left The zodiacal light as observed in August, 1939, from Mexico Cause, astronomical



Figure 3 Right. Moon, lunar halos and parselenae. Cause, refraction and reflection in ice crystals in the sir (explanation is given in Humphreys' "Physics of the Air")

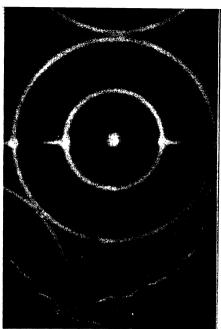
THE NIGHT

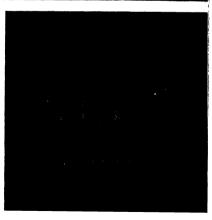
Striking Natural Phenomena . . . The Aurora, Zodiacal Light, and Bizarre Types of Lunar Halos

changed previous concepts of these once mystifying spectacles, and several theories have been offered as a consequence One theory supposes that the auroral light is produced by the biombardment of the molecules of aractical gases in the upper atmosphere by the ultraviolet rays of the Sun. These rays knock the electrons from the atoms to which they belong, in short, the gases are ionized. These multilated molecules them move toward the Earth, where they are attracted along the magnetic lines of force and produce the effect we know as auroral light. Another theory differs only in that tiny electrified particles are volently projected directly from the Sun. These are attracted spirally along the magnetic lines of force toward the magnetic poles of the Earth.

The least height at which the aurora borealis has been coorded is 4S miles, the greatest height being some 600 miles. The greatest number occur near the lowest level. The distances of auroral forms from the observer, and their heights above the Earth, have been computed with exactness. Especially designed cameras equipped with wide-aperture lenses and using rapid emulsion films are utilized for his purpose. Simultaneously from more apart, the exposures are made on the same auroral feature. These exposures are synchronized by means of telephonic communication between the operators, who wear headests. The resultant negatives are so marked that they may be compared with one another. The position of each camera with reference to the aurora.

Figure 5: Right. Aurora, arch type with vertical streamers, curtain type above it. Seen from Iowa





and the background of the stars always shows a parallax, or shifting; the meaured distance between two stations is the base line. In this way are secured two angles and the included side of a triangle. The rest is merely mathematical—the ordinary process of triansulation.

The latitude of maximum occurrence of the aurora boreals is not, as once was believed, at the region of the Earth; geographic Pole. The occurrence of greatest frequency is near the region of the magnetic pole, which is many degrees south of the North Pole, near the Aretic Circle in northly in Canada.

On any clear, moniless might in the vear the possibility is by no means remote that the observer may be the fortunate witness of a spectacle which, of all celestal thrillers, is second only to the total eclipse of the Sun—and this possibility also exists whether he lives in the lautude of Maine or that of southern Florida.

Another striking nocturnal marvel in no way related to the aurora is the phenomenon of lunar halo (Figure 3) to which similar solar halos are related because of identical cause—the refrac tion and reflection of light in tiny snowflakes or in needles of ice, most often when the clouds are low or when clear air contains the needles. The majesty and loveliness of either a lunar or solar halo and its secondary images are as inadequately describable as that of the aurora. with which they easily rank in beauty It is now believed that the celebrated cross which Emperor Constantine perceived in the sky, about A.D. 313, and which persuaded his conversion from paganism, may have been part of a sys tem of solar halos, two of which at right angles would form a cross

IN the common form of fully developed lunar halo, two concentric circles are produced, with the Moon at the center, the inner halo having a radius of about 22 degrees, and the outer halo about 46 degrees Passing horizontally through the Moon and through both halos is a track of light, the parselenic circle, of about the width of the Moon's diameter. On this horizontal track usually appear a number of secondary lunar images. the parselenae, the most brilliant of which are the two located near the intersections of the inner halo. The parselenae are brightest when the Moon is near the horizon As the Moon rises. they move somewhat beyond the balos and assume flamboyant tails which are directed away from the Moon. All the colors of the spectrum are delicately exhibited in the halo, owing to the optical phenomenon of interference. however, the only decided tint is red. and this color is invariably located on the inner side of the rings. A parselena, being itself a secondary source of light. often very brilliant, may in turn have to won encircling rings, not included in the drawing. These secondary halos, however, are much fainter than the primary ones. In addition, there may be a magnificent circumzenithal arc touching the outer halo at its upper point, together with brightly colored tangential arcs touching the lower half of the outer halo. These, too, can be explained as effection from effection from the frozen crystals. Not all the details described form in any given display. Indeed, ideal perfection here is rather trare.

Water crystallizes in the form of regular hexagonal prisms, usually with plane ends but sometimes with hexagonal pyramids as terminals, Now, if we con sider any two non-parallel faces of one of these crystals, it is clear that their combination must act as a prism, de composing white light, which passes through them, into its constituent colors The refractive index of ice, however is such that no ray of light can pasthrough a prism of it having anglegreater than about 991% degrees. Therefore, the power to create the halo effect must be limited to pairs of faces whose inclinations are inferior to this. In the present instance, that would mean the alternate faces of the prism where the inclination is 60 degrees, and a face with a terminal plane whose angle is 90 degrees. Every such crystal, then, suspended somewhere near the line joining the eye and the Moon, must send to the former some definitely colored ray from each effective pair of surfaces With the prisms having their axes in every possible direction, it is evident that the appearances produced must be sym metrical, and must therefore consist of circles around the luminary

Taking now the inner halo its appear ance may be explained by supposing the colorless portion to consist in part of the recombination into white light of its multitudinously separated elements by minute prisms, and also in part from the following cause. If a prism, through which a ray of light is passing, be turned gradually on its axis, the refracted ray also turns, but at a gradually slower rate, to a point called minimum deviation, from which point it will retrograde increasingly faster Hence as we have assumed the suspended prisms in the atmosphere to be in all possible positions, those near the position of minimum deviation will contrive to refract light in the same direction. and their effects will be consolidated All the others will cause a dispersion of light As the red rays are the ones that lie near the point of minimum deviation, there is consequently a red circle around the Moon with an angular radius of 20 degrees, 50 seconds, the angular radius of minimum deviation. Inside this circle there will be no light; outside. the light will be somewhat colorless and feeble.

The explanation and appearance of the 46-degree halo are the same as for the halo of 22 degrees, except that its position depends on the right-angled prisms formed in the hexagonal prism.

prisms formed in the hexagonal prism. Less specticular perhaps than the other phenomena described, but none the less mysteriously impressave, is that marvel of the night which manufest itself as a strangely clouve ethereal glow, concentrated along the zodiac — the broad path in the sky along which the bun, Moon, and planets appear to move — and which consequently is called the zodiacal light (Figure 4)

The zodiacal light, like the aurora, can be seen only on a moonless night After the last vestige of twilight has vanished in the west this phenomenon often appears in spring like a tenuous, luminous mantle of mist through which the stars seem to twinkle with almost undiminished brilliance. In autumn it is best seen in the east shortly before the first hint of dawn. Although not in frequently observed from higher latitudes, it is better and more often viewed from clear, and regions in the tropics, where its subtle golden drapery adds more than another touch of mystery to the night

THE physicist has determined that supshine. This discovery leads to the conclusion that the zodiacal light is in reality reflected light of the Sun coming from billions of minute meteoric particles moving in orbits of their own around the sun, and extending at least as far out as the Earth's orbit While we seldom see the complete band of the zodiacal light, it extends all the way around the ecliptic. On it, directly op posite the Sun, is a brighter area, the gegenschein, or afterglow, some ten de grees in apparent diameter. In this area each particle may be thought of as at full phase (exactly like the Moon though far smaller), and this accounts for its added brightness

The rarefied nature of the material in this region would seem at first thought almost incredible. It has been estimated that the small particles reflecting the sunlight are somewhat less than a millimeter in diameter, and are spaced from one another at about an average distance of five miles Therefore it follows that, if all these tiny bodies, distributed throughout at least nearly 100 million miles of radius, were to be condensed on the surface of the Earth, they would form a layer not exceeding one centimeter in thickness. In truth this material is so tenuous as to have no appreciable effect in retarding the speed of not only the planets, but also of the very tenuous comets that at times travel through its tremendous reaches.

FOODS X-RAYED

To Reveal Presence of Foreign Objects, Some Impurities . . . Also Condition of Products, Fruits . . . Fluoroscopic Inspection Widely Used

THE average person thinks of the X-ray, as a medical tool. The technically a mided person understands its importance in structural studies in engineering and industry. During the last four years this tool has made another important place for itself, this time in the food industry. The processors and packers of many types of food products have developed in recent years acreens, seven, magnetic separators and have applied photoelectric cells to the job of detecting and removing foreign objects from all kinds of foods, but fluoroscopic inspection has proved to be superior to them all in some respects. However,

the X-ray does more than show presence of impurities. In one case, three fluoroscopes, costing a total of \$10,000, gave a saving of \$60,000, which resulted when a large quantity of oranges which were scheduled for destruction were found to be undamaged by freezing

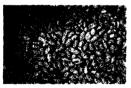
Right To show how a hox of candy gives up its secrets under the fluoro scope, foreign objects were inserted in some of the pieces of candy. The objects show up as irregular black spots in several of the candy pieces



Below Radiograph showing oranges as they appear on the viewing screen of a visual inspection X-ray unit Images of even density show an even distribution of juice while the mottled images indicate frost-bitten or crystallised fruit. Right Fluoroscopic inspection of lemons







Left Ashallow box of shelled peanuts ready for salting. To the eye, it shows no unwanted objects but the X-ray shows presence of many small stones. These show up as in the picture of box at right





Pebbles can be present also in such foods as blueberries, without being seen, left. But when passed between the X-ray unit and the fluoroscope, right, the berries no longer hide the adulterants



A BIG GUN OF SCIENCE

THANKS to the World's Fair and modern advertising, artificial light ming bolts, such as electrical engineers are useful resting purposes, have become as familiar to Mr and Vits. American as their livingstoom rug. The development of any instrument of pure or applied science invariable leads to the subsequent discovery of unsuspected uses for it. In the case of the "impulse generator," as the machine for producing artificial lightning is called, one title-known use was the disastregation of atoms. Before we can understudy that the size we must look back a few years.

In the middle 'twenties, a good deal was known about the outside of the atom. The behavior of the electrons, which move in complicated orbits about the central nucleus, was fauly well understood, hence scientists, looking for new fields to explore, were already turning to the atomic nuclei. They were trying to break them open and find out what was inside by shooting fast particles at them. Some success had already been achieved by using the alpha particles that shoot out of the nuclei of radioactive elements with velocities of about 20,000 miles per second; but many kinds of particles which scientists wished to use could not be obtained in this way. One method of reaching high speeds with these particles was to put them into an evacuated tube, where there were no air molecules to slow them down, and then to apply a high voltage This would accelerate them to the desired velocity. However, the obstacle which held scientists back was the tremendous cost of high-voltage equipment

IT was here that three pioneers of nu-clear physics — Brasch, Lange, and Urban -- took the bull by the horns. Between two peaks of the Monte Generoso, in the Swiss alps, they hung a long cable between two enormous chains of insulators. In this region, electrical storms are frequent, and they hoped to pick up enough atmospheric electricity for their purpose, either from direct lightning strokes or from the highly charged air beneath the thunderclouds. This hazardous improvement on Benjamin Franklin bore some fruit Sparks were measured up to 60 feet in length, representing somewhere between 10.-000,000 and 15,000,000 volts. Unfortunately, Urban, while working high in the air on th cable, slipped and fell to his death.

Brasch and Lange continued the work alone, but they soon managed to

The Brasch and Lange Apparatus, Old-timer in Splitting the Atomic Nucleus, Faces a Revival with Improvements in Generating Artificial Lightning

By C. W. SHEPPARD

obtain facilities for making high voltages artificially so they were able to out their umbrellas away and take their work indoors. Instead of a continuous alternating or direct current, as was used by other workers, they investigated the effect of sudden high-voltage im pulses or "artificial lightning" These heavy electrical "surges" were produced by an apparatus already well known to electrical engineers and physicists. In this scheme, a bank of electrical condensers is charged in a parallel connection and then discharged in series. Sunpose, for example we charge 12 condensers in parallel, with 200,000 volts If we then connect them in series, the voltage will add up to a resulting voltage of 2,400,000

A very clever circuit is used to effect this process of parallel charging and series discharging. The bank of concensers in charged in parallel through tubes of glass or rubber filled with water Unlike a metal wire, water will allow electricity to threke in, but resists any sudden electrical surge in much the same manner as a pneumatic cylinder controls the closing of a door. As the electricity flows into the condensers, the voltage across them, which is proportional to their charge, likewise increases.



At a certain critical voltage, a chain of

spark gaps between the condensers

flashes over and the entire bank of con-

densers suddenly discharges in series

Since the parallel connection is made

through water tubes which will not

The lightning collector, 11/4 mile long, used

A 2,500,000-volt impulse generator. Discharge takes place along chain of apheres in the center of picture

transmit electrical surges, the sudden discharge is prevented from wrongly taking the original charging connection.

When allowed to discharge across an external spark gap, an impulse generator makes a very impressive display. Due to the high current let loose, the discharge appears with a blanding white flash, accompanied by a report which makes the ears ring. H a block of wood is placed across the gap, it is blown into many fragments.

Having obtained the necessary high voltage source, Brasch and Lange next required a vacuum tube through which to shoot their atomic projectiles. For this purpose, they devised an ingenious and simple arrangement. Alternate rings of laminated paper and steel, separated by rubber vacuum gaskets.

were piled one on the other to the required height and vacuum pumps were connected below. The tube was usually immersed in a tank of oil for insulation purposes When oil was used, the tube could actually be designed less than knee high if it were to work at 2,500,000 volts Such conveniently compact construction would not be possible unless one were making use of the impulse principle With continuous current, gases would be produced in the laminated paper wall of the tube by the discharge, thus making a vacuum impossible. This does not happen in the case of the quick impulses, for, by the time appreciable amounts of gas have formed. the discharge is entirely over and the pumps can clear the tube out before the next discharge occurs

These two trail blazers did considerable pioneer work in atomic bombardment with their "heavy artillery"



in the early experiments at Monte Generoso

Shortly after the first history-making artificial disintegration experiments of the two English physicists, Cockcroft and Walton, at Cambridge, they checked the results with their technique and confirmed them In numerous experiments, they bombarded atoms of many elements, using protons (nuclei of hydrogen atoms) for their projectiles Although the impulse technique produces fair bombarding intensities when using protons, the most spectacular results are obtained with electrons. It is true that a high voltage impulse lasts only a few millionths of a second, nevertheless, the current during that interval is at least 1000 amperes. For this reason, if we take a very conservative view, such apparatus, discharging once every second, has an output equal to a continuous cur-



A blast of electrons from the hot tom of the tube produces a strong, spectacular luminosity in the air

tent of one thousandth of an ampere or more. Measurements show that about one quarter of this can be converted into bombarding electron current. The power of bombardment of such a 2,500,000 volt impulse generator, then, would be a little less than one horsepower.

This power may not appear to be large but when concentrated into a beam of electrons it produces spectacu lar effects. A thin metallic foil can be placed on one end of the tube so that the vacuum is preserved A small amount of residual gas in the tube becomes ionized by the discharge, liberating large quantities of electrons which shoot through the tube, traverse the thin foil and escape into the air. In this manner, beams of electrons can be shot many feet and can be seen as a blue glow in the air. If the electrons are allowed to strike a calcute crystal at will fluoresce, giving forth bright orange light, with the same brilliance as a 40 watt electric lamp Given one impulse, it will glow, or phosphoresce, so strongly that, after one hour or more, one may read by the light which it still emits Although the electrons will traverse the thin metallic window without doing any damage, if they are allowed to strike a thick metallic plate, they will blast out large craters

The impulse technique has been regarded in the past as a spectualir off-shoot of physics. Its shifty to do good work was questionable in the face of such competition as that offered by the cyclotron and the Van de Griff genor. At present, however, scientists are mulling over the possibilities of a Brasch and Lange tube supplied by a 10,000,000-volt surge generator which it is now quite possible to construct.

Let us consider one or two of the things which could be done with such an apparatus. It has important biological prospects due to its ability to accelerate electrons. In the treatment of tumors by means of X-rays, the biological action of the rays has been thought to be due to the fact that they knock out secondary electrons as they traverse the tissues. It is these electrons, and not the X rays, which presumably produce the desired effect. Unfor tunately, it has heretofore been necessary to go through all the roundabout business of accelerating electrons, bombarding a target, producing X-rays which can penetrate the tissues, and finally liberating other electrons which do the actual work Producing both X-rays and subsequent secondary electrons is a very inefficient process. For this reason, a better way to approach the problem is to have a source of elections which are fast enough to penetrate the tissues directly. This method is also superior because electrons can be focused by the use of electron "lenses, while X-rays cannot be focused by any method which has thus far been discov ered by science

PRELIMINARY experiments with a 2,000,000 volt surge generator are at present under way in the high-voltage laboratory of the California Institute of Technology, at Pasadena One object of these experiments is to try the effect of improved methods of making protons. to see whether they can be accelerated in the same large quantity as electrons If this can be done, another important use for the impulse method presents itself. In 1933, it was discovered that, by bombarding certain nuclei with atomic particles, a sort of hybrid nucleus could be built up which was unstable and soon broke down in much the same way as do the nuclei of the naturally radioactive elements such as radium This process is called artificial radio activity A use was soon found for this discovery Small quantities of these artificially radioactive substances can be prepared and formed into chemical compounds They may then be put into a living organism and their progress through the organism can be traced by following the course of the radioactivity with electroscopes or other detecting instruments. By the use of these biological tracers, much valuable information about the chemical behavior of living things has been obtained. The difficulty hes in producing large quantities of these radioactive substances. With sufficiently powerful charging equipment, the impulse generator can be speeded up to obtain several discharges per second With a few hundred amperes of protons at each discharge, the Brasch and Lange tube will be a good source of biological tracers

For Better Roads

SINCE the Federal government created the Office of Road Inquiry in 1893 to advase farmers how to build better roads, studies have been made continuously to learn how to build stronger and more durable surfaces. There have been few discoveries that have attracted widespread public notice, but progress has been continuous. Much of the work has been done in laborationis from which there have poured unending streams of small improvements that have completely changed the quality of our road surfaces. For example, the concrete roads built today example, the concrete roads built today



Scale mounted in front of steering wheel indicates degree of curvature

have twee the strength of the concrete varoads of the same thickness built 15 or roads of the same thickness built 15 or 20 years ago. The hit-or-miss construction of surfaces with gravel, sand clay, and similar materials has been replaced by use of materials of known quality, and new methods of finishing these surfaces with bituminous materials produce smoothness and riding comfort of the first quality.

Within recent years, both the highway program and the field of highway research have been greatly broadened. The end of the pioneer period of road construction has been reached. During the pioneer period the main objective was to place a surface of some kind on the network of main highways. This job has been completed but the enormous increase in volume of traffic and in the speed of vehicles has brought about the necessity for modernizing many of the roads built in earlier years. There is need for surface widening and road straightening to improve sight distances and eliminate sharp curves Grades need to be eased, grade crossings must be eliminated, and many other improveExtensive Studies of Present Highways . . . Visibility . . . Grades . . . Curves . . . Traffic Quantity, Quality, Speed . . . Data Aid Future Planning

By THOMAS H. MACDONALD

ments must be made to bring our highways up to the standards required by modern traffic

Attention can no longer be centered on the main rural highways alone. The congestion, delay, and accidents on approaches to cities and on the main ruites through them make it imperative that city and suburban improvements be provided without delay. At the same time, many secondary roads must be surfaced to connect agricultural areas with main highways.

THE problems before highway administrators are complex. To aid in their solution the Public Roads Administration is ecooperating with 46 state highway departments in conduct and highway planning surveys. All high ways are being mapped and detailed data are being collected on their condution of improvement and the volume and character of traffic over them. Studies are being made concerning the source of highway funds and how the funds are used. It is intended that these data be used in planning future highway improvements on a scale that will be adecusted for future traffic and that the pregram be conducted on a sound and

Special studies are lenng made to deversoformation to be used in establish, expecting and sught distance. The have been many technical discussions of these subjects, but lack of data on the characteristics of vehicles in motion has clouded conclusions. Apparatus now in use it and produced in the characteristics of the subjects in the facts.

Efficient management of the 46 state highway planning surveys has required the rapid development of instruments to aid in collecting large quantities of field information quickly and cheaply

A first requirement in the planning surveys was to innentory the existing highways to find where they were deficient in width, in surface type, in aliment, or in any other respect Carsused in the inventory were generally equipped with special odometers reading directly to bundredths of a mile or with "footometers" in which a trailing bi-cycle wheel records distance in feet on a dial mounted inside the eart.

Practically every mile of rural high-



Somewhat unwieldy but effective is this trailer boom developed in Michigan for measuring degree of curvature. Swing of the boom is registered within the car

grades, and those of 5 percent or more have been located and both the percent of grade and length measured. The varying grades common on hilly secondary roads were measured by anproximation only, generally by sighting from the bottom to the top of the grade, using a homemade substitute for a hand level called the "grade board." The uniform grades found on primary roads were measured accurately and directly by a commercial instrument which had been developed for use as an accelerometer This instrument, when mounted in a transverse plane, gave precuse determinations of the rates of bank ing on curves

Measurements of curvature presented somewhat more of a problem. The sumplest and cheapest devece, is designated as a "curvometer". This device consists of a calibrated scale mounted behind the steering wheel Somewhat greater precision was obtained in some states by the unwieldy yet effective trailer or "trailer orbid". The boom or chord swings behind the car in traversing a curve, and the amount of swing



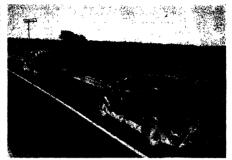
Permanent automatic traffic counter installed on a road in Maryland

is shown on a scale calibrated to read directly the degree of curvature.

One or two states adopted the aviator's directional gyroscope to determine curvature. This device, mounted in the front compartment of a car, shows the change of direction in rounding a curve, and the length of curve is shown by a "footometer." The degree of curvature can be calculated from these data.

One of the states most recently undertaking the work of measuring critical highway features has benefited from the work of earlier investigators and has incorporated a "footometer dial," a directional gyroscope, and an altimeter in such relative positions that all may be photographed by a permanently mounted camers at desired intervals, thus obtaining several types of data at the same time.

A means of measuring the distance the highway shead can be seen, or "sight



Sight distance is measured by these two cars 1000 feet apart. At that distance, rear car's horizontal rod will cover all checkered spaces on other car's rod

distance," was developed early in the surveys and has been used almost without change in nearly all the states. The problem was to locate and measure the length of all sections of highway with sight distance less than 1000 feet and to determine the shortest sight distance on the section Two cars are required. the front one being equipped with a specially designed stadia rod. A rod. mounted on the front of the following car, is of such diameter and at such height as to cover the entire stadia rod when seen by an observer seated normally in the front seat with the two cars separated by 1000 feet

The two cars thus spaced proceed along the road until one disappears from the view of the other. The rear car is then at the beginning of a substundard section. By a similar procedure the end of the section is located. The difference in readings of the odometer at the beginning and end of the section gives the length.

WITH means provided for deter mining road conditions, the next sten was to devise apparatus for use in studying how the roads are used Measurement of the service a highway renders is important in deciding how well it should be improved. The per manent type of automatic traffic counter, developed by the Public Roads Admin istration, has satisfied this need. In stalled at nearly 500 locations on both primary and secondary roads throughout the entire country, these instruments automatically count vehicles and detect the variation in traffic volume day by day and season by season.

In the housing of each recorder, there are two photoelectric cells, on which light beams, placed on the opposite side of the road, are focused. When both

the beams trained on these cells are interrupted by a wehicle, a circuit is nergized, closing a relay which, in turn, operates an electric counter. The total shown on this counter is automatically recorded by a printing mechanism each hour. Both light beams must be interrupted simultaneously to actuate the mechanism. A pedestrain or cyclist, who cuts only one beam at a time, does not actuate the counter.

To supplement these permanently instudied expensive machines, variously types of portable counters have been developed, some by manufacturers and some by the Public Roads Administra tion. One of these counters is actuated by an electrical contact made in a strip land across the road for detecting the vehicles. Vehicles passing over this strip close a circuit that, in turn, actuates the counter.

Engineers of the Texas highway planing survey have developed a portable counter in which a light beam actuates a photoelectric cell as in the permanent type, but current is obtained from a storage battery. This recorder uses a single light beam

In cases where it is not necessary to know the traffic by hours, but only during the time the counter is installed, simple accumulating counters nave been developed by the Public Roads Administration. In these, the passage of a which excluse a pneumatic switch A small rubber tube is laid across the road. As wheels pass over the tube, an air impulse passes through it and moves a diaphragm at its end.

In highway planning, there is need to know also the amount and kind of goods moving over highways, the weight of vehicles and their size. In the planning surveys, two separate types of weight studies were conducted. In one



Above A strip laid across the road actuates this portable traffic counter. When a car passes over this strip, an electrical contact is made, causing meter at right to register

study, large-capacity pit scales were permanently located on a few representative routes in each state, and the weight, height, width, length, wheel base, and capacity determined

An entirely datinct weight study was conducted on all the important roads in 46 states, using a commercial weighing device called a loadometer. In these studies, the flow of weight over the highway was desired to determine distances various agricultural commodities and in what proportion each commodity is found in the normal traffic. Such information is needed in discussing the ecoomics of highway transportation and in determining the part the highway plays in the field of distribution of goods

Special studies are being made to determine the capacities of highways of various widths, the times and distances required for passing maneuvers, and the normal driving practice under various highway conditions. The base equipment used in all such studies by the Administration has been the graphic time recorder. Observers stationed at a key at each end of a measured section, close keys to actuate pens and record wholes entering and leaving the section

Data on vehicle speeds are useful for many purposes including highway de sign, enactment of legislation control ing speed, safety studies, and enforcement of speed restrictions. Observation of a considerable number of vehicles supplies these data. Highway capacity uniformation, however, can be developed only from a study of the speeds of all the vehicles on sections of highway. Field procedures, therefore, had to be developed to next thus requirement.

A new method has been developed that involves the use of an extremely ingenious speedmeter. This device has as its basic element a lotary stepping switch. This switch, similar to those used in automatic telephone switch-boards, has a series of 50 points arranged in two tiers around the circumference of a semicricle. Each point is connected to one of a series of pens an a graphic-recording unit. A wiper arm, protected with the product of the semi-circle, when energized by a self-interrupting magnet, sweeps over these points, always moving at a constant rate of speed. The action of the switch is



somewhat similar to that of a buzzer, but the arm, instead of moving rapidly back and forth between two points, moves shead from one point to the next

As a vehicle crosses a detector laid across the pavement, a relay is actuated and the switch starts rotating. As the vehicle crosses a second detector generally spaced 24 feet from the first, another relay stops the switch momentarily and energizes the circuit connecting the point on which the wiper arm then rests and its corresponding graphic-recorder pen. The point the wiper arm has reached depends on the speed of the vehicle. The slower the vehicle travels the farther around the semi-circle the wiper arm moves before the second relay interrupts its motion By noting the pen that has been thrown and referring to a conversion table the speed may be found immediately

N determining vehicle speed with the speedmeter, other apparatus has been used to record the transverse position of vehicles on the road surface Positions of vehicles on the pavement are influenced by such factors as lane width, pavement strip markings, shoulder type and condition, and roadside objects as well as by the presence and speed of traffic in the opposite direction. Measurements of transverse positions were made with a contact detector laid on the pavement. This detector consists of steel strips held apart by a rubber arch similar to that used in refrigeratordoor gaskets As the vehicle passes over this detector, the arch is depressed, the strips are brought into contact, and an electrical circuit is closed. One of the metal strips is continuous for the length of the detector and acts as a common lead to all pens of a graphic recorder; the other is broken into 20 sections and an individual lead taken from each section. With these 20 sections connected to 20 pens of a graphic recorder, the transverse position of each wheel of a vehicle is recorded automatically

A number of methods have been used to determine the time periods and distances required for vehicles moving at various speeds to pass other vehicles moving in the same direction, but none has been sufficiently inclusive to permit a complete analysis of the movements of all vehicles involved in all types of passings. Using graphic time recorders actuated by pneumatic road switches. The Public Roads Administration has



Portable loadometer used to weigh trucks to determine traffic loads

developed apparatus that makes a continuous record of the movements of all vehicles over half-mile sections of high way. Pens in vix graphic recorders acconnected to penumatic detectors, each consisting of a rubber tube, covering one traffic lane with a pneumatic switch at its end. These detectors are spaced at 50-foot intervals on both sides of the road. In actual practice, a single tube is placed across the entire roadway but is plugged at the center line so that each half is an independent unit.

The charts in the machines used in these studies move at 36 inches per minute, to measure speed over the 50 foot section to closer than one mile per hour With this precise speed measurement and an easily-interpreted record of the path of each vehicle, the determination of the exact times, distances, and speeds involved in all types of passing maneuvers is a simple but somewhat laborious procedure These times and distances are essential elements in the establishment of sight distance requirements, but perhaps of more importance are the number and types of passings found in the normal highway traffic. The conditions under which passings occur both as to sight distance ahead and position and speed of other vehicles are of great importance in designing safe highways.

GOETHE LINK ORSERVATORY

Built, With Its 36-Inch Telescope, by Amateur Astronomers of Indianapolis . . . Financed by Local Enlightenment . . . Presented to Science

By VICTOR E. MAIER

NTEREST in the study of astronomy has mounted with surprising rapid ity as an indirect result of the pub heation, some years ago, of Scientific American's volumes, "Amateur Tele scope Making" and "Amateur Telescope Making — Advanced " Comparatively few persons realize the important part these books are playing in connection with the science

Among the many achievements of the 10,000 amateur astronomers who have made their own telescopes most

of them beginning with instruments six inches in aperture, is the new Goethe Link Observatory, at Brooklyn, near Indianapolis, Indiana, with its 36 inch reflecting telescope and five inch auxiliary instrument. This observatory was founded, financed, and permanently endowed by Dr. Goethe Link, an Indianapolis sur geon The large telescope was built and the observatory erected for the most part by amateur astronomers in the Indianapolis area Its equipment has been offered free of charge to those who can best use it, especially to the colleges and universities in the vicinity of Indianapolis Indiana University has supplied a research fellow to work full time at the observatory, which has also been visited by professional astronomers from all over the nation It

Right Constructing the massive 30 foot, 200 ton concrete telescope pier

Center The main telescope, constructed by Indianapolis regional talent

Rottom The observatory houses two telescopes. lecture room workshop engineer, of Indianapolis, obtained from the Corning Glass Works a 36-inch ribbed Pyrex mirror disk for Dr. Link. A machine for grinding the mirror disk concave and polishing it was built by Mr Turner, who also undertook the construction of the mounting for the telescope. The task of finishing, or fig.





is also open to the general public on Sundays.

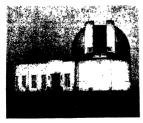
The idea had its start about six years ago when Samuel Waters, president of the Indianapolis Amateur Astronomers' Association, was giving informal lectures to the people of Indianapolis at the backyard site of his homemade telescope Dr. Link, believing there was enough talent in the community to build a large observatory, set about to finance such an institution and work began.

Carl Turner, a mechanical

uring, the spherical mirror disk to an accurate paraboloidal form was given to Charles Herman and V E Maier, both Indianapolis amateur telescope makers. The processes used were similar in principle to those set forth in the book "Amateur Telescope Making." the hible of the hobby, except that the disks of glass used as grinding tools for the main disk, instead of weighing about two pounds as in the case of the average beginner's telescope of six-inch diameter, weighed 200 pounds The same difficulties which perplex but fascinate the amateur who works on smaller mirrors were eliminated one by one until the mirror looked satisfactory under the delicate Fou-(ault knife edge test, which easily measures reflecting surfaces within an accuracy of at least one 500,000th of an inch

After 30 months of work the mirror was approved and coated in a vacuum with aluminum, the newer kind of reflecting film which has supplanted the more familiar film of silver. In the meantime, work on the other parts of the observatory project has been practically completed

The total weight of the larger dome. 34 feet in diameter, is 34 tons. The lower floor of the building, between the domes, contains an auditorium seating 150 persons, a dark room, astronomical laboratory, workshop, and a heated study room.



GHOST FORESTS

Insects, Number One Forest Enemy... Make Ghosts of a Vast Number of Trees... Bark Beetle Heads the List... Other Insects, Man Combat the Pest

By RUTH RINGLE

CONTRARY to popular belief, the Number One enemy of the forest is not fire but meets. In the year 1932, for example, less than 50 million board feet of tumber in California were destroyed by forest fires, while pine bark beetles ravaged 1500 million board feet in the ten years between 1926 and 1936, the State of California, alone, lost 200,000,000 worth of timber through the activities of these insection.

One day there is a majestic forest of whispering pines, a wealth of scenic beauty as well as of timber. An infestation of bark beetles moves in, and in a few weeks many of the trees are dead in some areas a whole forest of pines will become white. Infelies ghosts

Pine bark beetles are not alien enemes that have slipped mto our forests unchecked by natural enemies. They are a native menace. For centuries bark beetles have periodically ladd waste to pine forests, and in about 150 years a new forest would take the place of dead trees. Such is Nature's deliberate and protracted plan.

The destruction of great trees in their prime may suit Nature's plan, but it is disastrous to men, they cannot wait 150 years for natural replacements of the bark bectles' undoing. We also resent the esthetic and recreational loss to vacation lands.

Suppose a man buys a section of for cet land as a summer home for his fam ply They build a cabin beneath the pines and spend one health-giving, hap y summer there. The next year they py summer there the next year they return and find their trees dying. Bark beetles have ruined their meeting in the vacation resources. This family would not be philosophical about Nature's long-rance had.

Perhaps a few men pooled their sawings and bought a rich stand of pine forest which they planned to harvest in true timber-conservation procedure, assuing not only a life income for themselves, but also a rich bequest to behanded down to their children Then, before a single log had been cut, an epidemic of bark beetles swarmed in and changed their valuable forest to dying trees. There would be no consolation trees. There would be no consolation

in the fact that Nature would replace

The Bureau of Entomology and Plant Quarantine of the United States Depart ment of Agriculture has tackled this problem in a thorough and practical way the last few years. They have set a corps of entomologists to study the bark beetle, learn its life habits, its frends and enemies, and decide on the best method of control.

tain pine beetle. Dendroctonus Montico lae Hopkins, are the worst transgressors in ponderosa pine and sugar pine for ests These beetles are always endemic, constantly at their nefarious work, and only waiting for favorable conditions to become epidemic Bark beetles fly to a pine tree and bore holes through the outer bark to the living tissue, the cam bium layer which carries the sap or life blood of the tree, rich moisture, resins and dissolved sugars. At first, the beetles are forced back by the protective flow of pitch, but so many attack a single tree at one time - literally thousands that within a few days all the sap is exhausted and the tree can no longer fight against its enemies Then the bectles move in. By pairs, they start boring tunnels through the living tissue of the tree, with a pocket-crib every so often in which the female deposits eggs Soon the cambium layer is a network of these tunnels.

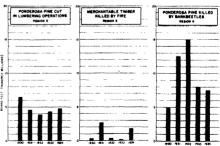
The eggs hatch into larvae which feed on the sugars and other substance of the dying cambium tissue, then become pupae When growth is completed, the young beetles bore their way out of the dead tree, fly to another living host, and begin a new generation.

When endemic, beetles usually attack only trees which have been weakened by some other cause such as lightning or the attacks of other insects. The largest trees, also, when fully mature, do not have the tonucity to fight the bleeding tactics of beetles, so the most magnificant period of the property of the property

Soon after the insects enter, the tree is no longer able to draw enough mosture and food elements to sustain list and the pine needles turn to a sickly yellow, then a yellowish brown, and finally, before the needles fall away, to a red, rusty stage. The dead, whitened trees may stand for some years before they fall.

Besides being a scar of ugliness, these dead trees are a menace to neighboring forests. Dead trees magnify the danger of fire, from whatever cause, by providing added inflammable material to that already on the forest floor.

If logged within a few weeks after a bark beetle attack, trees can be salvaged for some lumber uses, but after about six months, the tumber is worthless. The wood by that time is honey-combed by other insects. A fungus-caused "blue stain" discolors the tissues, and dry rot



Comparison of damage to commercial pine stands by lumbering, fire, and heetle

rapidly turns tough fibers to dusty pulp.

The problem of how to control the stateske of bark beetles was approached from two angles, surveys and laboratory research By surveying the condition and number of beetles and other insects, and considering the weather factors, it can be fairly well determined whether or not an epidemic is immunent. If so, immediate control measures can be instituted.

IN the mountains east of Fresno there is an unusually fine stand of sugar pine, the most valuable timber material in the forest. This area was recently surveyed. Ground crews marked and mapped all infested trees in this forest while a supplementary reconnaisance from an airplane spotted dying trees by their red crowns. Then insect control crews entered these areas and felled all infested trees, many of which were over six feet in diameter and about 500 years old The bark was stripped from each felled tree to expose beetles and larvae. then bark and log were set afire Felling and burning trees that are hosts to beetles has been the most successful method of control so far discovered

Three years ago the Bureau of Entomology and Plant Quarantine established two field research laboratories in the heart of pine forests, one near Yosemite National Park and the other near are of the bark beetle he attacks, and he approaches his prey without hesitation, flips it over on its back and may be expected in a witherable of the he proceeds makes mere of he vetter the proceeds makes mere of he vetter of the proceeds makes mere of he vetter of the proceeds of the proceeding t

Forest entomologists are breeding both green trogositids and red-bellied clerids in their laboratories to determine the feasibility of large scale artifi-



A forest of ghostly gray trees, all kills by an attack of vast numbers of bar beetles on the cambium layer of bar



Bark beetle in the grip of one of his natural enemies, the red-bellied clerid, which devours both the bark beetle and its larvae

Lower lest Clerid larva feeding on beetle larva in tunnels beneath tree bark



Lassen National Park. Bark beetles have received the primary attention at these laboratories because they are the most serious problem. Healthy trees were screened and beetles introduced so that the scientists could observe the actions of the beetles and the reaction of treetothe attents.

Then predators, enemies of beetles, were admitted to this living laboratory, and researchers had a ringside seat at a major forcet bout. But it wasn't much of a fight, for bark beetles hardly raised an antenna in their own defense when attacked by a green trogositid or redbellied clerid, their natural enemies.

A red-bellied clerid is about twice the

cial rearing of these predators as a method of beetle control These preying insects need careful raising, and as they breed but one generation a year, it is difficult to get enough trogositids and clerids to be effective against bark beetles in large

Another factor in favor of the beetles is that clerids and trogositids do not depend solely on bark beetles for food. They like a varied diet, so that even if the predators were not outnumbered by the beetles, they could not be depended on to wipe out the

pended on to wipe out the peats However, entomologists are still working on the problem and hope to find a way to breed these predators more economically and abundantly, or to the cover other more practical and effective parasites or predators. Somewhere else in the world such a parasite may be found

the world such a parasite may be found. Other methods of control have been tried. Toxic oils that seep into bark and poison the insects and larvae are successful on thin-barked trees, but as pine bark beetles usually attack trees with thick bark, toxic oils are no threat to them.

Entomologists, are studying a bark beetle disease, an organism on the borderline between plant and animal life which sometimes wipes out an epidemic of beetles, but little has been learned If this plague could be introduced by foresters when an epidemic of beetles threatened, it might be the simplest method of control

It will probably never be possible to wine out bark beetles completely, but even the control program now in use, felling and burning infested trees, if applied thoroughly and consistently, would prevent devastating epidemics. Wherever this method has been used, it resulted in a loss-reduction of 50 percent to 80 percent

Ande from the loss of trees, these depreciations of beetles entail further problems. Trees, above all things, are a natural control for floods and excesses onli crosson. Pine forests are an important part of our national wealth, and are the basis for many industries and pols leades those of actual lumbering operations. But who can measure the entire of the comparation of men since the ensupration of men since the designation of men since the legislation of the size of the constraint of the size of the constraint of the size of the constraint of the size of the siz

Foresters agree that an effective control program must include plans for thorough and basic research, must be sufficiently wide in scope to include any territory from which infestations could migrate, and should provide for sustained effort over a period of years



ONTHEL DIG

Conducted by F. D. McHUGH

Indian Arrow Poison For Arthritis, Mental Disease

TWO powerful poisons, cobra venom and curare, the old indian arrow poison, have been put to use in healing two wide spread human afflictions — arthritis and the mental disease schizobhrenia

mornal under extension production arrow poston protects patients from juny during metra sol convulsions which are used to shock them back to sainty Good results with this combination of curare and metrazol are reported by Dr. A. E. Bennett, of Omaha, in the Journal of the American Medical Association D. Bennet cautions against general use of the posson with metrazol until further experiments have been made He has sails." in treatment of whiden suffering from seastic paralysis

Deadly colvar venom imperied into the muscle of patients suffering from neural-gia and various rheimatic conditions caused slight or moderate improvement in a little over half the cases. Drs Otto Stein brocker, George C. McEarbern, Emanuel P. La Moita and Freeman Brooks, of New York City, report Other methods of treat-work of the color of the patients. Patients with rheumation at arthritis were helped more by the cobra venom treatment and the color with off the companion of the commendation of the color of

ENAMELS FOR PLASTICS

THE wide use of plastics in bulk for such things a radio calment, electric ron handles, and the like his long good a problem to researcher. To put color in these plastics, expensive pigments are necessary. Yet Shewim-Williams Company chemists fell that the color need not go deeper than the surface. They set about finding enamels that would do the trick, and the recently announced one called a color of the color of the

These new enamels can be dinned or

Contributing Editor ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

sprayed on plastic parts, and combine any color of the rainbow with an extraordinarily long-wearing surface. Moldings which are now being finished with these new coatings are for vacuum cleaners, electrical wiring devices, and automobile parts.

Most Powerful Testing Machine

A NEW type of precision metal working machine, which is also the world's most powerful testing machine, was demonstrated recently at the Aluminum Rosearch Laboratories

This huge piece of equipment, called



Above Testing to destruction a riveted joint (in center of picture). Right: Press forging an aluminum ingot in the same machine

the Templin machine after R L Templin, chief engineer of tests of the Aluminum Company of America, is capable of exerting a force of 3,000,000 pounds in compression and 1,000,000 pounds in tension Research executives point out that while it is not the largest machine of its kind.

it is the most powerful, for it can exert these forces at speeds up to 36 inches a minute — faster than any other testing machine, and, since power equals force times speed, the claims made for the machine are evident.

The new machine, built by the Baldwin-Southwark Corporation, can be operated as an extrasion, forging, or forming press in addition, it is provided with auxiliary equipment which will permit defining, within close limits, the relationships exist ing between the various forces involved in the plastic flow of aluminum throughout a wide range of conditions.

The over-all height of the machine is 40 feet, 4 inches, of which 25 feet is above the floor line, the rest below. It is 16 feet, 4 inches wide and 9 feet front to back.

NODULES FOR INSULATION

HARD SHELLED, light weight nodules for processed and puffed clay that have been produced by the Kraus Research Laboratories are being used in several types of insulation. They may be used as a filler in building blocks, hollow tile, stucco, wall plaster, partition boards and the like.

These modules, which may average a quarter of an inch in dismeter, are made of fatty clay or shale having high carbon content. If the clay or shale is deficient in carbon, the manufactures add a solution of glucose, pitch, or soft coal finely ground, as gas forming substance. Sometimes it



is necessary to add Bentonite as a plasticizing agent, this material acting also as a flux. When heat is applied, the semi-plastic body stretches into a balloon shaped piece because of the confined gaves from the carbonaceous material. When properly heated the surface is glazed to a hardness that will withstand pressures used in the process of making building block-

90mm Antiaircraft Gun

To supplement the Army's 3 inch aniaircraft gun, a new 90mm weapon wasrecently announced by the War Department. Some comment regarding this has appeared in the daily papers but so far no reclaimed details have been released for publishing details have been released for publishing and probably will not be released. The warof its shell, 90mm, or slightly were 7.54 inches, will indicate its increased power.

Both the gun and its ammunition have undergone technical and engineering tests and have been standardized. Hence, some of these guns will be procured instead of three inch type which are now being manufactured under current appropriations.

ROOF WATER COOLS

SiNCE the time when primitive man finally crawled out of his cave home to conceive a habitation of his own creation centuries of effort and millions of dollar-have been expended in draining rain and snow water from rooftops.

Not until our present evolution and the recent developments of air conditioning did man begin adapting water as an insulation and seek means to hold it captive on roofs to turn back the sun's heat in summer and reduce the escape of inside heat in

For the builders of commercial and indistrial structures, the Koppers laboratories in a Pittsburgh have developed roofs which are capable of holding pools of water for musilation. The have been found to reduce the degree of the company of the comtact of the company of the company of the comtact of the company o

Structures with air conditioning, too, are using pool roofs because they make it unnecessary to dispose of water once it has circulated through the system. Now it can be pumped to the roof, cooled of its absorbed heat, and re used over and over again.

RURRER

ACCORDING to the Chemical Digest, of Foster D. Snell, Inc., "rubber" supplies are about 1 percent synthetics, 28 percent reclaim, and 61 percent crude rubber.

IT STARTED WITH MAGGOTS

DURING the World War it came to the notice of medical men that bad wounds that became infested with squirming maggots of the blowfly healed much more rapidly than the same type of wound uninfested. Search for the resson finally centered upon a secretion of the maggots called allanton. Further study found that one constituent of allanton was the effect.

tive curative agent. This chemical was urea. Now it has been found that a still simpler chemical, ammonium bearbonate, has the same effect as urea. Ammonium bearbonate is formed naturally from urea by the action of an enzyme, uracar. A 1 percent solution of this chemical is effective whether used as a wet pank or for irrigation of an open wound. Some of the conditions cleared up by the new treatment were chrome osteomieths, diabetic and surrows ulcers, middle ear infections, stitch abovesses, infected lacerations, and other nurrient words.

PORTABLE PRINTER

A NEW portable printer, announced by the Ozalid Corporation, was designed to use positive printing, dry developing Ozalid sensitized papers and cloth. It is claimed that it will reproduce, engineering drawings, letters, reports, maps, in fact, any pencil or ink lines, bysewritien or printed matter appearing on one side of a reasonably translucent sheet.

The light source consists of six specially developed lamps. A new feature is a dry developing chamber, which is conveniently located behind the metal reflector, utilizing the heat generated by the lights to vaporize the developing agent.

This light and portable unit can be carried from place to place, and used either in



Printer, lid removed to show lights

the office or in the field on the job. Since no most surface developing solutions are used, no washing, fixing, or drying is required. In an office, prints can be conveniently made at a moment's notice by any office employee. The cost of making prints on the Elippo Portable Printer is but a fraction of the cost of making such re-productions by other photocopy methods.

TO DETECT METAL BUBIED IN LOGS

A DEVICE for detecting spikes and other metal objects burned in logs has been developed by the Forest Service, U.S. Department of Agriculture Metal objects in logs are potential causes of coatly and sometimes fattal saw-smashing accidents

The device was developed for use in connection with lumbering operations in New England, because an unusually high percentage of "blow down" timber in some sections hit by the 1938 hurricane was found to conceal old fence nails, harmook hocks, spikes, shandnord sugar sap spouts,



Exploring coil and detector box of device for locating hidden metal

and even sections of forgotten scythe blades. Near Vermont marble quarries miscel lancous bits of iron and rock, apparently blasted into the tree trunks and grown over, also have been found, as was a jackkinfe left perhaps by some initial carver of other days.

The detector is easily carried by one man When the exploring col with which man with the exploring col with which it is equipped is held near a log in which metal is inhelicided, the device sets up a lovel. By moving the coil the operator is able to locate the exact position of the burred metal. Armed with this informs ton, the assumilier then chops out the metal before the log goes to the saw and a mostable reach.

possume crack up

The detector consists of a lox about the
size and appearance of a portable radio
set, to which the file, tem the exploring
coil is attached by a sax-foot, flexulle were
greater to be a substitute of the consistency of the
primars of a shoulder strup, the operator
carries the lox upon ins bip so that adsummer knobs controlling butteres and
upon the controlling butteres and
the controlling butteres are provided to the can better
catch the detector's how! and other sawmulti noise.

When the instrument is turned on, an audio tone signal is set up in the head phones. By tusting the knobs, the operator balances out the signal. When the exploring coil is brought into the vicinity of any metallic object the balance is disturbed and the audio tone signal is heard anew.

PEANUT BUTTER

THE oil does not separate from peanut butter when 2 percent of glycerin has been added. Glycerin as of course, a food.

2000 Degrees Fahrenheit Portable

A GENERAL utility torch of improved design has been introduced by the Utilitorch Company Primarily designed as a weed burner, it also serves as a disinfecting torch, tar-pot heater, and pre-heater for welding

Due to the fuels used — kerosine, distillate, stove and fuel oil — the coils on previous units became clogged with carbon and required frequent replacement. How-



Bow and side views of the largest twin-engine airline

ever, a specially shaped generator on the new unit, known as the Utilitorch, provides casy cleaning by simply removing the generator shell and reaming out the carbon Also, the new generator allows a more uniform application of heat to all the surfaces, giving greater fuel breakdown, more heat, and less carbon formation.

Both the generator tubes and generator shells are made of Inconel to withstand heats in the neighborhood of 2000 degrees. Fahrenheit The Utilitorch is available in five models from the standard hand model to the giant model for tractor and truck attachment for burning weeds along highways, irrigation ditches, and canals

LARGEST TWIN-ENGINE AIRLINER

M ANY authne operators are of the opinion hat to build four-engined planes is to lose operating economy, that two powerful engines give all the safety and rehability necessary, that a twn-negined plane will be more economical to operate, hesides being cheaper mitalily. The experienced executives and engineers of the Curtiss-Weight Company hold the same opinion and have backed this opinion with the expenditure of perhaps a million dollars in the construction of a fine twin engine

The specifications are, briefly 108 feet in span, 75 feet in length, 38,000 pounds in weight, fully loaded, 1000-gallon fuel capacity, 36 passengers by day and 20 in berths at night, two 14-cylinder Wright Ucklone engines with 15-foot propellers, top speed, 243 miles an hour, cruising speed, 210 miles an hour at 10,000 feet altitude

We have become so accusomed to the fact that transport airplanes provide more luxurious accommodations than the best Pullman that it is hardly necessary to speak of comfortable and adjustable recluming chairs, sound-proofing, ventilation, heating, and so on Let us concentrate rather on some of the new airrefit

The airful has been so modified at the tip that aileron control can be retained be-

namic innovation is to be found in the engine cowling. The air is introduced into the cowling at the front and circulated around the cylinders in the conventional manner. But after the air has done its cooling duy it is discharged through a single passage below the nacelle. It is reported that considerable reduction in drag is thus obtained. A. K.

SAFETY PLANES FOR PRIVATE FLYING?

THE Civil Aeronautics Authority is doing a fine job in its various activities
of safety regulation, aids to scheduled
navigation on the artines, training of college men in fyring, and so on But again
and again rumors reach us from Washing
to that the CA A will encourage private
flying by sponsoring the construction of a
marcaclous safety plane, which will be
cheap, efficient, and perfectly fool-proof So
taking flight instruction in the new safe
plane will be permitted to solo or secure
to the control of the collection of the



low the stalling speed. Thus the plane can execute a three-point landing at minimum flags in the plane can be considered by the plane and the plane and the plane and the sale roam nove directly aft during take-off to improve the run and subsequent climb. On landing they are also revolved downwards to accomplish ar braking. Blind flying technique will be further extended, and aircraft may then have to "mush" straight into the ground in anticipation of such development, but good in anticipation of such development, but ground with the necessary cushioning provided by extremely long block absorber travel.

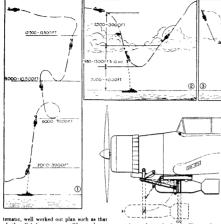
The geometry of the landing gear has been so worked out that when the airplane is on the ground there is no possibility of the landing gear folding, even if the pilot applies power to retract it. As long, in fact, as the weight of the airplane is on it, the landing gear cannot be retracted

It is a great help to the personnel to have only two engines to watch. To amplify their task further, Currias Wright engineers have reduced the number of flight controls by one third. This has been accomplished with the aid of a "Tell-Tale" safety device which automatically checks the functioning signal in one spot when any instrument; a shift of the safety of the

when using a more conventional machine Remembering the sad history of the \$700 "flivver" plane, we pray that the Civil Aeronautics Authority will undertake no such adventure rashly There is no such thing as a completely fool-proof plane and there never will be, just as there is no fool-proof automobile and never will be Whenever an engineer deliberately undertakes the design of a "special safety" plane he fails. Safety of the airplane increases by evolutionary stens slowly because each new idea has to ness through the various stages of laboratory experimentation, experimental construction, and long experience in service, before it can be fully accepted. Safety of aircraft advances always, but there can rarely be "jumps" or "sports" as the biologists term

Macrover, we are convinced from become personal experience that the nodera private plane is already remarkably safe, easy to control and manever. Quite recently, when control and manever. Quite recently, when the control and an according to the Luscombe small bightness of control and the stability that the typical light plane provides for the novice pilot. When the stick was pulled all the way back, the ship nonced up, oscillated one or twice, but never fell off on a wing This behavior in itself is a real element of serodynamic safety. When compared with the war time Jenules and other early training planes, the present state of the art seavor of the miraculover.

What is far more important is good instruction of the student pilot on a sys-



tematic, well worked out plan such as that of the CAA program Of equal timportance is the indocurnation of all student pulson in avoiding over-confidence and showing off. Accidents in private flying, as analysis indicates, are not histly to be due either to structural or engine failure or the flight characteristics of the arripance, but to some rash or imaguaded effort of the young plot, who after 40 or 50 hours in the air, believes himself to be equal of a Lindbergh or of an Al Williams — A K

THE ART OF DIVE

IN these parlous times we must perforce be interested in such gentle arts as dive bombing, and an article by H F King in Fight is illuminating

Dive bombing is defined as the release of a bomb or bombs while an airplane is diving steeply towards a target Previously, dive-bombing with heavy projectiles was regarded as of use only in attacks upon ships and in the Spanish war a single pilot is said to have accounted for the destruction of three large steamers But the German attack on Poland showed the value of the method in attacking tanks, and generally in support of infantry The speed of the dive increases the vertical velocity of the bomb so that its penetration is equal to that of a projectile released in level flight at a great altitude. Aiming for the target is of course much simpler than in bombing from great heights. Therefore, in spite of the fact that the dive bomber is peculiarly vulnerable to shell fire at low altitudes, dive bombing must remain a powerful aerial tactic.

The bomb itself, which may weigh as much as 1000 pounds (with heavy casing where penetrating power is required) is placed under the fuselage. A simple displacing gear, shown in the sketch, is opevated to release the bomb. The arplane tited must have special characteristics. It must be strong enough to withstand the must be strong enough to withstand the manner tited of the strong of the properties of the strong of the properties. And finally, it should be equipped with a double flag, one opening below and one above the wing surface to check the speed of the diversal than the strong of the properties.

The technique followed is illustrated by the accompanying diagrams in clear weather there is an approach from great all tudes, with intervening spirals. When there are some clouds the military awator seeks to fifty above the clouds and only penetrates the clouds to release his bomb. When there is an unbroken layer of cloud, he fires above, pieces it, and then flies through again until he is almost above the target -d/K

INDUSTRY BORROWS FROM THE HOUSEWIFE

O IIT of the kitchen has come the invelopment in the metals industry—the
efficient melting of zinc in industry—the
efficient melting of zinc in industry—the
humble double-boiler with which Mrs
Smith cooks her vegetables to just the
proper turn has been adapted; on heroic
scale, to smooth the wrinkles from the
brows of industrialists plaqued with the
expense and impurities of conventional
methods.

Down at the Glenn L. Martin Company aircraft factory has been developed this useful system, because Martin uses much of the metal in making dies for bombers and over-ocean transport ships

Heretofore, zinc has been melted simply by putting it in a pot and then putting fire

The three numbered drawings show different dive-bombing maneuvers that are used according to cloud conditions. Left Displacing gear for releasing agrial hombs

3000-10000F1

under the pot. But heat has concentrated at certain points, the zinc has alloyed with the pot metal at these points, and the melted product usually turns up with importues. In addition to this, the pots have been short-lived, eroding at the points of maximum heat

It was to produce hetter metal for dismaking, and at the same time reduce the cost of pot replacement, that the Mattin research staff developed the double-boiler does. They built a big pot with a combustion chamber underneath (for gas, oil, or coal) and covered it with refractiony material control of the control of the conmolien mass they dip another pot containing the zine. Since the heat thus is evenly distributed over the port, there is no tendency for the zine to alloy with the poi, the metal is returned in molten form in a high degree of purity, and the inner pot points of extreme heat.

BONDED CARBON STEEL-

STAINLESS SHEET

A NEW bonded sheet of carbon steel with a surface of stanless steel takes advantage of the cheapness of the former and the attractiveness plus corrosonsresstance of the latter. This new sheet is made by the Allephent Luddum Steel Corporation Plant and is called Pluramelt The process produces single injust of two or more compessions integrally bonded to remove the carbon beautiful to the contract of the contract of the contract of the contract of the carbon beautiful to the contract of the contract of the carbon carbon contract of the carbon carbon contract of the carb

The bonded material lends itself to standard shop practices as it can be fabricated in any of the usual methods

RADIO-ACTIVE

SPARK PLUGS

A METAL which has a commercial valuation of \$2,000,000 an onuce is now being used in spark pluge made by Firesione. Polonium is the metal, and it is used only in minute quantity. As a result of this use, the manufacturers, The Firestone Tire & Rubber Company, claim better motor performance and quicker starting; and asy, further, that many drivers using these spark.

The air around spark plug electrodes is

not normally a good conductor of electricity and must be broken down into ions by high voltage before it will conduct the spark between the electrodes This ionization takes time and may contribute to the sluggishness of a motor But, since polonium gives off 4000 times more alpha rays per second than radium, the polonium electrodes are emitting rays constantly in all directions, thus keeping the air in the spark gap ionized It is, therefore, at all times a good conductor of electricity.

UNDER FEED STOKER AIDS PIPE SMOKER

SMOKING pipe with an under-feed stoker is the development of Briar Hill Corporation This stoker, which can also be fitted to a smoker's present favorite pipe, is an aluminum screw-fitting in which



. a cool, dry smoke

is mounted a screw topped by a perforated aluminum grate

When the pipe is loaded the elevating screw is all the way down in the pipe, providing maximum tobacco capacity. As the tobacco burns down, the elevating screw is given a turn or two, raising the fuel. The elevator is thus run up, leaving a dead space below the grate in which juices can collect without affecting the tobacco's taste The Briar Hill Stoker promises the smoker a cool dry smoke with no accumu-

lation of soggy heel in the base of the pipe

How to PILE INDUSTRY'S COAL

A THOUSAND tons of coal a day — that's the requirement of The Dow Chemical Company And when any one industry's coal requirements reach figures as large as that, several major problems of handling and storage present themselves

For three years now, this company's unique and revolutionary coal handling and storage methods have been attracting nation wide attention Wherever coal is used in huge quantities, these methods are either being studied or have already been adopted

Until 1937, the coal was stored in conical piles of 8000 to 12,000 tons each. Coal was dumped directly from lake boats was piled loosely just as it fell, allowing free entry to air. In such a pile, natural classification soon caused a separation of fine and coarse particles, the former being more firmly compacted than the larger pieces. When a second load was piled on the first, the same thing happened. likewise with each succeeding load In case of fire the layers operate like flues in much the same fashion as their counterparts in chim-

It was often found necessary to re-pile the coal in order to eliminate this fire hazard This involved expense, but the cost was minor compared with the loss sustained when fires started

Coal is now stored in horizontal rather than oblique strata This climinates the formation of flues and reduces the fire hazard. There is little need to fear anon taneous combustion since coal is packed so tightly that little of the fire-breeding coal, of course, cannot oxidize. In the three years that Dow has been storing its coal thus, no rises on temperature have been noted, even after 18 months of continuous storage Formerly the average rise was one half degree per day

EQUALS LOW FUEL CON-SUMPTION MARK

THE low fuel rate of 0.545 pounds of oil per shaft horsepower, set by her sister ship the Challenge and believed a world record, has been equalled by the new Red Jacket on her official trial run The ships are two of five cargo vessels completed last year by the Federal Shipbuilding and Dry Dock Company at Kearney, New Jersev. as part of the extensive construction program of the U S Maritime Commission ships have General Electric geared turbine propulsion and are capable of developing 16 knots They are single screw, 6000-horse power. 92-revolutions per minute, with steam conditions of 440 pounds, 740 degrees. Fahrenheit, total temperature, and 11/4 inches absolute back pressure A sixth vessel is nearing completion, and Federal is starting construction of eight more such ships with the same type of propulsion

SUB-IRRIGATED SEED FLAT

A NEW type of seed flat designed for use in the home, the cold frame, the hot house, out-of doors, or for purposes of research in the laboratory, has just re-

Seed Flat Company Measuring 12 by 14 by 3 inches, it is made of rust-resisting metal and employs an entirely new method of watering which



Getting water to the roots

allows for sub-irrigation without any messy leakage of soil or disturbance of seed or seedlings as so frequently happens with above-ground watering. An inner plate having widened openings at each end and perforations in the corrugations in the bottom, permits water to be poured in and seep up through the perforations right to the surface of the soil Usually two or three quarts of water are sufficient for oisture to appear evenly over the surface Then a screw plug in the bottom of the flat is withdrawn so that any excess water may be removed. Further watering is not usually necessary for a week or ten days Air circulates through the end openings and the corrugations in the inner plate so that the soil is kept sweet and in good condition

This new type flat is also excellent for transplanting as it is only by sub irrigation that one can be sure water is supplied direcily to the roots Surface watering rarely penetrates more than 1/4 to 1/2 inch and, naturally, dries out more readily than when sub-irrigation is applied to the plants. Any possibility of damping-off is avoided by sterilizing the soil in the usual manner -(F Greeves-Carpenter.

NON-DRYING MODELING

CLAY

MODELING in clay has disappointments other than the unexpected errors in appearance which the fingers of the modeler may unintentionally make. There is the problem of clay hardening This may take place overnight if the unfinished model is not covered with wet burlap or unless some other means are employed to keep the clay surface soft enough so that additional clay will adhere firmly. Greatest irritation and expense to modelers



Red Jacket, cargo vessel that equalled best fuel economy record

result, however, because the clay canno be used over again once it has hardened thoroughly.

Manufacturers of articles molded from glass, metal, synthetic plastics, rubber, and similar materials may wish to use clay mixtures for producing "visuals" before production begins This new clay mixture enables such manufacturers to save time by making alterations in the models in stead of making new models because the usual clay types harden quickly

To make modeling clay retain its plasucity for long periods, small quantities of glycerin and petrolatum are added The glycerin attracts water to the mixture, keeps it soft; the petrolatum gives the mass the desired consistency Either 00 Petrolatum or Amber Parmo is suitable for this application. The amount to use depends on the consistency desired The amount of glycerin also may be varied, depending on the length of time the modeler wishes the finished model to retain its softness, or the number of times he wishes to use the clay - Esso Othways.

ELECTRIC STOPWATCH

DIFFERING from the conventional store watch, a new device, Time-It, made by Precision Scientific Company, has a direct-reading counter mechanism driven by a synchronous motor The principle of op eration is the same as that of the ordinary electric clock and the accuracy is said to he "equal to the cycle constancy of a 60



cycle a c supply at 110 volts" The five digit counter reads directly to 1/10 of a second and integrates to 10,000 seconds before running back to zero Readings closer than 1/10 of a second can be inter polated and the counter can be instantly reset to zero from any reading

Stopping and starting are by push button built-in brake eliminates "coasting" A built-in brake eliminates when stopping the timing operation. The device is said to be practically noiseless in operation It should find wide use in all types of laboratories where exact controls are necessary

WHITE CHROMIUM

MANY firms are now actively studying the possibilities of white chromium solutions because of the saving in plating time, much better throwing power, lower current densities, and resultant improved production. A wider bright-plating range, along with lower current densities, reduce burned edges and rejections.

White chromium is flexible, very resiscant to peeling, rust-proof, non-tarnishing, and white. Other concerns are investigating the promising possibility of white chromium for barrel and basket plating which would

How Mickey Mouse joined our family

by Westinghouse



- · "Plastic dishes with pictures of Mickey Mouse-how in the world did Westinghouse get into that line?" asked a buyer. Well, it's an odd story, showing how the logic of production sometimes leads to surprising answers.
- · Among the many electrical products that we make are the outlets, switches, plags, fuses and other little connections needed in a wiring system. They are known as Bryant and Hemco wiring devices, and are made in our factory in Bridgeport. In 1928, when the amazing possibilities of plastics were startling industry, we took over a nearby plastics plant to mould these various devices.
- The capacity of this plant was greater than our needs, so we either had to cut it down or find new uses for plastics. About that time, scientists created new plastics in vivid, rainbow colors-marvelously suited to tableware, toys, smokers' fittings and hundreds of such things. It seemed a long jump from dynamos and motors, but we had the plant and the plastics, so we plunged into the new field.
- · Famous designers went to work - skilled tool makers made

hundreds of new dies - we hired salesmen who knew dishes and tumblers rather than switches and plugs -and almost before we knew it, had an important new business on our hands.

- · Our first big hit was with children. They were delighted with fascinating dishes decorated with pictures of Mickey Mouse, Snow White, and other lovable people who live in story books. We have sold millions of dishes glorifying Mickey and his gang! And millions of gaily colored spoons, plates, tumblers and kitchenware, all identified by the well known names they bear -Hemcoware or Safetyware. That ashtray on your desk, the plastic housing of your new electric razor or the beautiful plastic cabinet of
- · Today, this plastics plant Is busy with orders from chain and department stores from all over the country from sales organizations who use these products for premiums and novelties . . . and from manufacturers who are using plastic parts in their products.

your bedside radio-they probably

are all of our make.

· To us Westinghouse people, trained as we are to do years of research before launching a new electrical product, this overnight success that seems almost to have come out of the air, is startling and refreshing. Actually, of course, it did take a lot of planning and good team work - but still, it's fun to look back and see how Mickey Mouse came to join the Westinghouse family.

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SANDING DRUM HAS INNER TUBE

A SANDING drum which relies on an abrasive band in place is being manufactured by Mall Tool Company. Finer finishes, with less danger of tearing the work or putting excessive wear on the abrasive



Air pressure holds the band

hands, are promised. The Mall Pneumatic Sanding Drum is easy to apply to any flexible shaft machine, bench grinder, or aerial grinder.

grinder
The drum is a lightweight aluminum
casting, having a special, flat rubber tube
mounted on its outside face A fabric band
and the belt of abrasive material are
slipped over the deflated tube and into correct position. Then a few strokes with the
arr pump inflate the tube, and the belt is
held firmly in place.

The Mall drum can be fitted with any one of several grades of abrasive belts, from very coarse to very fine. The light weight of the aluminum drum is a great advantage when the device is used on a portable grinding tool that must be hand-held and carefully manupulated in grinding castings and finishing fine surfaces. — Aluminum News-Letter.

LAKE BROMINE

THE American Potash and Chemical Corporation is installing facilities at its plant at Trona, California, to recover bromine from products resulting from the evaporation of Searles Lake brine.

The bromuse concentration in Seatles Lake brine is about 12 times that of sea water, and since large quantities of brine are processed in the Trons plant for the recovery of potash, borar, soda ash, sail cake, and other chemicals, a considerable amount of bromme is available. During another of bromme is available. During categories of the property of the property

Theoretically, the main Trona process is a cycle one of alternate concentration and fractional crystallization in which the brine is ultimately evaporated to dryness, with separation and recovery of the various salts contained therein. Thus, in certain of the concentrated liquors, the bromine concentration reaches 100 times that of sea water It is from such concentrations that the bromine is to be recovered as a by-product

DESK ORGANIZER

A HORIZONTAL filing cabinet for use on a busy executive's desk, where he can keep important papers that will need attention in the near future, has recently



In this horizontal filing cabinet there is a choice of 45 standard titles for identification of contents

been developed Known as the Miracle Desk Organizer, this compact filing cabinet is equipped with classified folders large enough to take legal-size papers

"CASE HARDENING" CONCRETE

IT has been discovered that if concrete forms are lined with absorptive, finely textured material such as Fir-Tex mailar imploared, the concrete will develop a hard, dense surface, which might be called case hardened. The absorptive board case hardens the surface of the concrete by remover of the concrete by remover of the concrete by remover of the concrete surface, and the concrete with the acade possesses a very danse, voidless, outer layer extending to a depth of about one and one-half inches

TETANUS TOXOID

PRETANUS is one of the most serious problems of wartime medical science An open wound may pick up the germ from soil, manure, or ordinary highway dust Commander W W Hall, U S Navy Surgeon, recently announced that a toxoid for vaccination against the disease has proved so successful that after injections of two doses eight weeks apart, the individual becomes a walking antitoxin factory He says, further, that the entire Naval Academy personnel has been vaccinated against this disease and if wounded, will never again need to be injected with horse serum or face the danger of serum reaction

More Shaving Science

THE Mellon Institute fellowship of the Magazine Repeating Rano Company is enabling E. J. Cascelman to investigate the variability in askety ranor blades and its causes on the one hand, and the variability in shaving conditions on the other, including their relations to user satisfaction (Mr. Cascelman works for Scientific American, November, 1937, an illuminating discussion of some of his findings.)

It has been found that there are some 31 variables in shaving conditions that influence user satisfaction, of which the more



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important are: time of heard softening. temperature of softening water, hydrogen ion concentration of soan or other medium. time elapsed since prior shave, and condition of skin and hair as influenced by fa tigue, by sunburn and windburn, and by dietary factors. The variation introduced by these factors is roughly twice as great as that in the over-all quality of new razor blades as produced by the better blade makers. A study conducted in supplement to this investigation has shown that there are some 24,000 hairs, each about 0,006 of an inch in diameter, that the typical man has to shave on his face and adjacent por tions of his neck. The effective length of most safety razor blades may be considered to be divided into 240 segments, each 0 006 inch long. It follows that the mini mum amount of work required of each such segment in an average "once over" shave is to sever 100 hairs. Still more work is regured in the usual case where the skin is shaved over more than once. The degree of hair softening by the facial preparation before shaving determines in part how many hairs can be cut before the blade becomes too badly dulled for further use

MILEAGE

THE United States has far more high-speed railroad mileage than any other country Today, runs scheduled at 60 miles or more per hour total 65,034 miles, of which 54,956 are completed daily Runs booked at 70 miles or more per hour cover a total distance of 8068 miles

To KEEP CATS AWAY

A BOON to owners of cats is Pussy Scat. a new powder which keeps cats off chairs and beds and away from curtains. table legs, and other objects on which he likes to use his claws Pussy Scat is sprin kled lightly on or around the places that the cat must avoid It is harmless, invisible, and odorless to humans when used in accordance with the instructions. Yet the cat smells it, and stays away It ends the shedding of hairs on chairs, beds, rugs, and so on, and prevents other "cat damage" in the house Pussy Scat is made by the Sud bury Laboratory, makers of indoor and outdoor dog , epellents

SPRAYED MIRRORS

SINCE mirrors were first made, the silver reflecting medium has been applied to the back of the glass by a slow process of flooding the glass with the solution by hand The solution then must remain on the glass surface for 20 minutes to an hour to secure a satisfactory deposit of silver After a long period of research, the Peacock Laboratories, Inc., a division of Libbey-Owens-Ford Glass Company, have developed a new process which involves spraying of the solution on glass as it passes down a production line. With this process, 12 square feet of silver film can be deposited on a glass surface in less than 60 seconds according to Chemical and Chemical Engineering News

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SCIENTIFIC AMERICAN 24 W 40th St., New York City, N.Y. developed reducing agent From these tanks, the two solutions are forced by compressed air through a two-nozzle spars guin. The nozzles permit the sprays to meet about seven inches in front of the nozzles so that the two solutions are atomized It is at this point of mixing that the silver starts to precipitate.

The hazard of chemical and handling damage occasioned by the variable of human skill is reduced to a minimum, since the glass plates, after being placed on the slat conveyor and washed are not touched by the operators until completely processed

The silver reflecting medium deposited on the glass surface by spraying is said to be extremely white and brilliant, and to reflect greater detail, truer colors and distance. It is a tough, tight, dense, home geneous film with durability and longevity

VERSATILE LABORATORY

DESCRIBED as an "all-around laboratory muxer" the Model "F" Laboratory Mixer has been announced by the Mixing Louinment Company

Aside from its portability and ease of handling, the chief feature of this new



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mixer is its adjustable speed friction drivilt provides constant horsepower at the propeller and increasing torque with slow speeds A turn of a conveniently placed thumb seres uncreases speed up to a miximum of 1750 revolutions per minute, or decreases speed until the mixer is barely turning over

The new model, mounted on a special ring stand clamp, may be used on beakers as small as 300 cubic centimeters without spilling or "throwing out" contents. They have been used on tanks up to 20 gallors in size to produce gentle agitation A convenient carrying handle makes it easy to use as a hand mixer without clamp or stand.

This mixer is recommended for use with inflammable materials since the motor is totally enclosed.

OPTICAL TEST FOR CANCER

A NEW optical test that tells whether a for operation, that cancer has been successfully treated, is claimed by Dr. M. W. Mettenledizer, New York surgeon, connected with

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St. Clare's Hospital. In a preliminary series of 325 cancer cases, the test is ro ported to have proved 96 percent correct Developed from German studies reported

over the last 30 years, the Mettenleiter test involves the measurement of the densities of a number of samples of the person's blood serum by use of an interferometer. The blood serum from the patient is mixed with an extract of human cancer cells from a nationt known to have carcinoms of the breast

Varying amounts of the suspected patient's blood serum are placed in four test tubes containing equal amounts of the cancer extract. After incubation and settling, the densities of the four dilutions are obtained, and plotted out graphically The curves are reported to show a charac teristic difference between cancerous and the non-cancerous blood serum -- Science Serme

ALCOHOL:

PRODUCTION of ethyl alcohol for December, 1939, was 22,080. 109 proof gallons, while the procohol was 10,502,486 wine gullons. For the corresponding month in 1938, the figures were 16,780,614 and 8,372,981, respectively

INK CRUST SOLVENT

PRINTING plates, type, fountains, half-I tones, and other printing equipment often become coated with hard incrusted ink, but a new solvent called Fedroid instantly removes such incrustations, leaving no residual odor or film of grease. This material is a compound of several chemical ly pure solvents and will not injure fabric, wood, paper, or the operators' hands It leaves metal surfaces bright and clean without pits, etching, or other effects of chemical

WEIGHT GAIN AND LOSS IN WOMEN

REGULAR gain in weight of about A two pounds during one week in every month, with subsequent loss of this gained weight, occurs in about 50 percent of women as a result of monthly variation in sex hormone activity, according to Dr George W Thorn, of the Johns Hopkins School of Medicine, Baltimore This weight gain, unexpected and perplexing, has caused much discouragement to women on reducing dieta and even to the physicians prescribing the diets, Dr Thorn pointed out The two pounds gained is due in part to retention of excess quantities of water and sait, as a result of the regular change in sex hormone activity - Science Service.

No More

LEAKY FAUCETS

DO YOU know anything more annoying than the steady drip of water from a leaky faucet? Well, did you ever do any. thing about it, besides trying to twist the faucet down tighter? If you're like most of us, you put off installing a new washer as long as possible. However, one designer did

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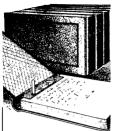
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do something about the problem-he developed a faucet that stood up under several million closures

The faucet and valve which success fully survived this unusual laboratory test work on a ball bearing principle. The upper race of the bearing is attached to a bolt which, in turn, becomes part of the stem assembly. The lower race turns freely on



Ball-bearings do the trick

this bolt and holds a soft neoprene washer in position. As the faucet and valve are turned down, the bottom race of the bear ing rotates with the upper race until the washer touches the valve seat Thereafter. the bottom race does not turn. On further turning, the soft washer compresses against the valve seat to effect a leak proof seal

There are many advantages claimed for this ball bearing faucet and valve. A few of them are the mechanism prevents faucet dripping, saving owners considerable expense, it reduces fuel costs and saves replacements and annovances, it eliminates rotative wear caused by twisting the washer tightly down on a metal scat, the faucet can be opened and closed by mere finger tip action, this smooth up and down action, instead of violent twisting, permits the use of a soft neuprene cushion. It has been found that the neoprene washers can withstand extremely hot water for an indefinite period of time

METAL ETCHING SOLUTIONS

FOR etching aluminum and its alloys, Dr B Egeberg and N E Promisel recommend, in Metal Industry, that freshly polished and cleaned specimens be warmed in hot water and treated immediately with the following etchant Nitric acid, 1 vol ume, hydrofluoric acid, 2 volumes, and glycerin, 3 volumes. White metals such as tin, lead, antimony, bismuth, and their alloys, as well as Britannia metal, may be etched with the following Nitric acid, 1 volume, acetic acid, 3 volumes; and glycerin, 15 volumes. After etching, rinse in running water and dry in an air blast.

CHEMICAL "ICE" FOR SKATING

FOR many years attempts have been made to develop a chemical ice for yearround skating rinks. Some success has been had with such simple chemicals as sodium hyposulfite, which is the commercial hypo used by photographers. Skating surfaces made by using some of these products have been satisfactory to a degree but all have had certain disadvantages.

There has now been brought to a high point of perfection a combination of chemi-



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cals called Iceolite. This is claimed by Chemical and Chemical Engineering News to be the first substance which permits year 'round unrefrigerated ice skating. It was conceived by Bessie Pastor Berliney some years ago and is now manufactured by the Iccolite Corporation.

iccolite has a number of advantages, not the least of which is that it has better wearing qualities than natural ice and may be re surfaced casily and mexpensively Exceptional durability and fast glide are characteristic Furthermore, it is harmless to person and clothing. Its standard color is a light water green but other colors may be supplied

BAKED ALUMINUM

BAKED aluminum finish of excep-A tional beauty and resistance is a new development in industrial finishing. Called Heresite A 313, it is made by Heresite and Chemical Company. The appearance is that of tarnished silver and it is, therefore, attractive for household devices such

as radiators, pipes, washing machine parts, refrigerators, and many other types of apparatus such as auto heaters, fans. blowers. airplane parts, and the like

The new finish has excellent adhesion and high resistance to mechanical abrasion and weathering It is said to have withstood successfully 450 hours of continuous exposure to salt spray, a test that would hadly injure an ordinary coating

NEW POWER TO THE FARM

WITH new two- and three plow tractors, today's small acreage farm can be completely power equipped for less than \$1500. The new small models will mechantre 3,000,000 more farms, it is estimated, and will supplement larger tractors on 3,000,000 bigger farms

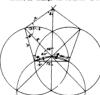
Tractors are rapidly attaining higher standards of engineering and refinement More powerful and economical to operate trimly streamlined, with self-starters, enclosed cabs rubber tires, and other appointments, they are replacing older models

SOLUTION TO THE PROBLEM

OF THE PENTAGON

AST of Lieutenant Commander Kap-Ilan's series of 14 problems, beginning in the April, 1939, number, skipping to the September number of the same year, and appearing regularly thereafter in this department until last month, has the following solution

Consider the triangle shown in the sketch.



whose angles are 0. ,, and 60° From the sine law, we have

$$\frac{\frac{r}{2} \sec 15^{\circ}}{\sin \varphi} = \frac{r}{\sin 60^{\circ}}$$
which reduces to

sin φ = 12 sec 15° vin 60°

$$\varphi = 26^{\circ} \cdot 38^{\circ} \cdot 02^{\circ}$$

Adding this value of φ to 60° and subtracting from 180° gives $0 = 93^{\circ} \cdot 21^{\circ} \cdot 15^{\circ}$

0 + 15° - 108°-21'58 which is the value of the angle of the pentagon at either extremity of the base Completing the solution of this triangle.

$$\frac{z}{\sin \theta} = \frac{r}{\sin 60^{\circ}}$$

we have

Taking next the triangle whose angles are \$, 45°, and 135° -- \$, the sine law again yields the relation

un & un 45°

Combining and climinating z from the two equations. sin & - sin 93°-21'-58" sin 45° esc 60°

and S 54°,375,47"

Two other angles of the pentagon will have a magnitude, each of 135° --9 + φ = 107° -02'-15'' and the angle at the top will be

25 - 109° 11′ 34″ The construction is not exact, and is in error by the amount the angles fall short of or exceed 108°

The pentagon problem shows a construction for a regular pentagon, which is attributed to Albrecht Durer, German painter and engraver, who lived from 1\$71 to 1528 It is not an exact construction, but it is a very good approximation. The method of executing it is so simple and practical that none of its accuracy is lost in the process

MRST of Licutenant Commander Kap First of Lieutenant community of the five proposed in the April, 1939, number, page 219, these being entitled The Prob iem of the Crossed Ladders, The Problem of the Spheres, The Problem of the Barge on a Rock, The Dog and Rabbit Problem, and The Second Dog and Rabbit Problem More problems were published as follows September, 1939, page 171, Problem of

the Circular Pasture. October, 1939, page 236, Problem of the Cylinder

November, 1939, page 301, Problem of . the Weights.

December, 1939, page 361, Problem of the Swimming Dog January, 1940, page 42, Problem of the

Square February, 1940, page 110, Problem of the Chord and Arc

March, 1940, page 173, Problem of the Medians

April, 1940, page 237, Second Circular Pasture Problem.

In every instance except the first, the solution to these problems was published in the number following the dates stated above.

YOUR FIREARMS

and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS to traditional with American men, fishing tackle is a required of one of the world's added to expairons. Scientific development of gains and tackle, in the use of which millions yearly find quot and recreation, lathers this monthly department, which welcomes correspondence from readers.

WELCOME, FISHERMEN!

CENTLEMEN of the angle, we welcome you to this gathering place of immreds and fisherined. With this issue, the gun fancers move along on the bench to make room for their brother sportsmen, the claim of rod and red. And yet we strongly suispect that many of you who have been visit ows to this monthly round table on arms and

come, fisherman' Hall, gumer'

IN THE SPRING—SKEET

TO Mrs. Gettrade Hurlbut, Montana
Trancher's sife, sent a \$100 prize in
1926 from National Systeman and Haining
and Fishing magazines for christ-timing their
newly spinsored shogson sport "skeet"—
sandanavan divration, menning, "to
shoot to arms and ammunition makers,
tolting mandariurers, silver, smits and
the U.S. Tra-siry hav, since thin, gon
annually hundreds of thois-saids of solidiers

nodes sponsored shotgan sport "skert"— Sundanavan dirvatten, meraning, "to shoot Io arms and ammunition makers, tolding manufacturers, slots similis and the U. S. Frasury have, once then, gone annually humbreds of thousands of dollars for guns, shells, "larid," traps, shooting ackets, uniform, meranic sportswart cupand other trophies, and Folcael cases taxement of the shoot of the devotes of all ages, both seves, in any kondof of wather, from humble homes and maginteent man-sons, to "shoot a round of skert".

ingly, from now on this department will strive to offer to both hunter and fisherman

news, developments, and controversial grist for their respective "hot stove" mills. Wel-

Folked in 1915, introduced in 1926, skeet's still sky rocketing popularity continues to please its sponsors, delight gon and munitions people, contribute its share of 1 nile Sani's special taxes, and intrigue new competitors. From modest and scattered inceptions at Ballardsile, Massachu setts, I-dmonds, Washington, and Valhalla, New York, skeet clubs are numbered in



Captain Grant Heeng

ors to this monthly round table on arms an

ammunition need but to glance in your shaving mirror of any morning to find simultaneously the reflection of both an angler and a bunter

We take our sports in season, we Americans, and come fall or winter, we think of upland game and deer, of wildfowl and indoor range targets. When spring, with her outdoor stimulus, bursts upon us, our thoughts may stray from the category of tranctories, loads, long shots with scatterguns and the reverberating roar of indoor pistol and rifle fire to realms piscatorial. True, the shotgun enthusiast comes into his own with the nice weather and the flight of skittering skeet and trap targets. Outdoor ranges are active, woodchucks must be wary indeed to avoid the ardent rifleman, but many a gun addict is lured from the smell of powder by memory of Izaak Walton's immortal, "Oh, sir, doubt not that angling is an art. Is it not an art to deceive a trout with an artificial fly?"

All these occupations have come to be parts of our lives largely through scientific development and research. Without science, the knight of the bowing rod and the devotee of the trigger would alike miss many of the pleasures which are their's. Accord-

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in the March 1940 issue of The American Rifleman



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S K E E T and how to SHOOT IT

By BOB NICHOLS

To the skeet devotee this book will be a friendly, helpful critic in pointing out possible existing faults of form, stance, fit of gun, target lead, and other factors which may have tended to interfere with perfect scores. To the inexperienced skeet shooter it will be a complete and competent guide to the above named phases of the sport, as well as to choice of guns, constructive suggestions and extensive information on eyes and shooting glass es, clothing, field lay-out, and the entire game from station one to station eight. The author writes in clear, graphic style, gained from his own extensive experience in skeet shooting and from his knowledge and background as Arms, Ammunition and Skeet Editor of Field and Stream. (177 pages, 6 by 91/4 inches, 46 illustrations.)—\$3.60 postpaid.

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GUN COLLECTING

By Charles Edward Chapel

(1st Lt U S. Marine Corps, Retired)

Any gun fancier who has never ridden t hobby of firearms collecting will, in all probability, reach the last page of this book with the firm resolve imm augurate his hitherto neglected gun gathering activities A pleasing, parretive style thly and rapidly motivates the pres tation of historical and informative date on antique arms and the pleasure and profit to be had from their ownership Although written for the novice, and therefore equipped with an excellent glossary, index. bibliography, and source lists of collectors, ms, and periodicals dealing with the hobby, the veteran also will find this volum well worth adding to his library (232 pages, 5 by 7 1/2 inches, 15 illustrations). \$2 60 postpaid

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SCIENTIFIC AMERICAN 24 West 40th St., New York, N. Y. thousands, have attained to sumptuosanes and social status of country clubs, number among ultra - democratic memberships butchers, bakers, candlestuck-makers, who contest shoulder to shoulder with bankers, executives, auto manufactures international manufactures in the sum of the shoulder with bankers adoption in Belgium, Ganada, England, Egypt, France, Germany, Noway, Sweden, South Africa, South America Credit for keet's universal appeal goes to its sportive



Courtesy Abercrombie and Pitch Skeet guns

competition, its year-round opportunities to duplicate field shooting conditions for practicing bird hunters, the inherent desire to fire a gun, and the never outgrown, adolescent thrill derived from deliberately smashing something

Named Captain of the 1939 All-American skeet team, big, blonde Grant Ilseng hails from California, participates in tournaments all over the map, holds such titles as the Great Eastern 20-gage, the California State 20-gage, small gage, and high over all, and boasts a season's all-gage average of .986 on 1550 targets. Illustrative of types of guns which will powder millions of birds in 1940 are the Marlin Model 90, "Skeet king," over-and under, the Winchester Model 12, repeater, the Francotte Model 25, double barrel; the Remington "Sportsman" automatic To benefit skeet neo phytes, "Bob" Nichols, Field & Stream firearms editor, has exhaustively covered the subject in his book, "Skeet, And How To Shoot It

Who'LL Raise the Cane?

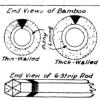
IT'S possible that your favorite trout, bass, or salt water fishing rod traveled much farther before it came into your possession than it has since, for Tonkin cane, that sturdy, virile, properly flexible backbone of America's choicest rods, is grown in China The Waitsap area, near the borders of Kwangtung, Kiangsi, and Hunan provinces, some 175 miles north of Canton, is probably the birthplace of your favorite rod Although bamboo grows in many sections of the tropics and subtropics of both hemispheres, none of the growths offers the necessary rod-making qualities found in cane from the Waitsap area, where climatic conditions produce almost perfect bamboo, Calcutta cane advocates notwithstanding, and where our future delicate "fishing poles" are known locally as "tsing lee poles"

For many years Tonkin cane was sys-

ror missy years 10 notic cance was reremancially harvasted by the Chinnese populace and carefully seasoned in enormous lace and carefully seasoned in the control of the transferred to Hong Kong-bound river boats, then re-loaded again for its transpacific vorage. Today, bowere, to a large extent, the Chinese have been driven out of Waitasp and the Japanese govern the land where grow our future split bamboo roda. Report of the first as to harves, and, consequently, as to imports of Tookin cane under present corruentances. One importer claims no Tonkin is being cut or stored: A well-known ord manufacturer asys that sithough Tonkin is popularly supposed to have ceased coming into this country a year or two ago, the Japanese now control the entire crop, employ Chinese labor, and that thus far there has been enough on hand to supply the makers of high-grade rods Be that as the country as the country as the country and the same that our future supply of Tookin cancould and may be threatened.

When the much traveled Tonkin cane gets into the hands of the good red manu facturer, it is split, not sawed, because he anlitting the natural grain of the wood in followed and a stronger rod results. If you were to cut a section out of your rod, you would probably find it composed of six tri angular atrus of hamboo, neatly matched as to similar grain, and, if it's a really good rod, the inside apex of the triangular pieces of split bamboo would be hard and firm, like the outer edge. Without this stout heart, your rod would be firmsy and spine-To avoid such wilting action, manufacturers of quality rods use only butt pieces of Tonkin in which the bamboo wall is of sufficient thickness to permit eplitting the triangular strips without encroaching on the pithy lining of the cane

Having mentioned that you would probably find your rod composed of six triangular strips, it's apropose to state that this type of construction is used by rod manufacturers today after exhaustive tests and because it has proved most satisfactory throughout the years. Behind the adoption of the six-strip rod, however, lies a brief history of



Top sections show why thick-walled cane is best for rods. Lower drawing. How rod sections are fitted

these fiath begetting instruments. In 1847, a Mr Luttle, of 15 Fette Lune, London, arof maker to his Roval Highness, Prace Albert, began making rods from "three rent process" Thomas Aldred, another London er, maugurated his hire-strip process about the same time An Easton, Pennalyvana, guinnaker, Samuel Phillipp, brought out a four-strip rod in 1862, and was followed eight years later by H. L. Leonard, of Bengor, Maine, with a sat-strip construction. The well know, with a sat-strip construction. The well know lifted by the Reddicker Selfanon, differed their six-strip Reddicker.

But getting back to present-day methods of rod manufacturing. Nodes, which are the regularly spaced knobby parts of the bam boo, are staggered in assembling the trangular strips so that no two nodes will come opposite each other. When strips are split for rod construction, these small areas of tough cross grain must be spaced so they will alternate in any given section. And speaking of sections, rod makers cannot emulate the assembly line of auto manufacturers They do not build a supply of butts. pick up any mid-section from the rack, and end up with a casual tip, or tips. No, sir! When you buy your trout rod from your favorite dealer, you may rest assured that if it bears the name of one of America's leading manufacturers, it has been properly matched as to grain, and that it is the prod-uct of a careful "tailor made" process Like wise, the strips have been selected with an eye to exact fit at each ferrule, so that it has been unnecessary to cut down the bambos to attach the ferrule

As to which rod, how long, what weight that's a story in stell. The decision resis on many things, including type of fish, lake angling or strengthings, and the size of the latter. Are you going to fish fresh water or sait seas. Will it be west of two vork for trout? Or is it salmon? And it can be bass, pickerel, pandish An outstanding factor is the preference of the fisherman, hings factor is the preference of the fisherman, hong factor is the preference of the fisherman extension of the preference of the fisherman in the preference of the fisherman extension of the preference of the fisherman extension of the preference of the fisherman that the preference of the fisherman extension of the preference of the fisherman extension of the preference of the fisherman extension of the preference of the preference

"ALL-AMERICAN" TROUT FLIES

THERE is probably no more controversal subject among anglers who use artificial lures than, "Which are the best flies?" A year ago National Sportsman printed one of our stories entitled, "What Fly, Mr Fish erman?" and accompanied it with a ballot and an invitation to the nation's trout ang lers to designate their choices. They wer asked to name the six dry flies, six wet flies, and six streamers or bucktails they had found most productive. The poll drew replies, some most emphatic, from 23 states and named 319 different patterns. Using a point system of scoring, it was found that Royal Coachman was the decided favorite in both dry and wet classifications. The idea back of the story and its sequel (National Sportsman, March, 1940) was to at tempt to simplify the perplexing problem of selection of trout lures, of which there are over 10,000. We figured that if enough of the country's trout fishermen told us which flies they had found most successful, we would have something to offer toward settlement of that ever ponderous question

With that in mind, we sent the completed data to The Weber Lifelike Fly Co., who promptly furthered the idea by printing a folder depicting both national and regional results of the survey. They capped this by packaging "The All-American Fly Selecincorporating the six winners in each of the dry, wet, and streamer-bucktail categories within one box. Now we don't for a oment contend that possession of a set of "All-American" flies is a panacea for all trout fishing ills, and neither does Weber Like the choice of a rod, individual preference and experimentation will, within cer tain sensible limitations, ultimately determine which flies you like best. As one voter in the survey so aptly put it, "The manner in which the lure is presented and worked has made many a poor lure productive and many a good lure fruitless." However, several fishermen have told us that the survey helped, and if you'd like one of the Weber folders showing complete results, just let us know.

Pot-Shots

AT THINGS NEW

W R ("BILL") WEAVER, maker of that sensational 1-power shotgun 'scope, as well as the famous Weaver 330 and other scopes for small and large bore rifles, has announced a substantial reduction in the prices of his scattergun 'scope. This product has proved such a boon to beginners and to others who want to improve their shooting that the demand has increased to the point where production tools and quantity manufacture have be-come possible, thus bringing about the new price of \$19 on the Type T mount, which formerly sold for \$27 50 The type B mount, which used to sell at \$31, can now be had for \$22 50

WHEN KIPLING Wrote, "Boots boots -boots -boots-movin' up and down again! he, of course, had in mind the incessant tramping feet of an army, but the quotation could as well refer to the army of trout hshermen who slosh up and down the nation's streams and rivers. Without a good pair of hoots the trout angler is lost. There's nothing which so literally and figuratively dampens the Waltonian's ardor as the constant trickle of ice water into the rubber casing about his pedal extremities With that in mind, the Goodrich Footwear Division of the Hood Rubber Co., Inc. announces a new wader-top boot with light, flexible rubber legs extending well above the knees to provide longer wear and reduce danger of snagging Special fabric, coated with highest grade rubber com pounds, is used in body portion for light ness, flexibility, and long wear Another feature which will be welcomed by every angler who has at some time slipped and gathered himself a bootful of water is that these waders can be turned completely inside out, right down to the insole. In a unique pamphlet called, "Fishing Facts and Fancies," the Hood people display all their wares and offer some authenticated "tall" tales, such as the one about the catfish found in a tree, 40 feet above ground, the salt water denizens of New Hampshire's fresh water lakes Drop us a card and we'll send you a copy

ITHACA GUN COMPANY ADDOUDCES & DEW member of its popular "Model 37" family New arrival is Ithaca Model 37R, a repeater, available in 12 gage with 26, 28, 30, and 32 inch barrels; in 16 gage with 26, 28, and 30-inch barrels; in 20 gage with 26 and 28-inch barrels, all with any standard degree of choke Outstanding feature of Model 37R is "dead level" solid, raised rib with no dip, no sway, no ramp to interfere with true sighting plane. The found at rear end of sighting rib on several makes of popularly termed "ribshotguns", causing difference in height between top of rib and top of frame, has been eliminated in Ithaca's Model 37R, thereby establishing absolutely straight sighting plane from the breech to the very muzzle of the barrel



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Conducted by JACOB DESCHIN, A.R.P.S.

APING THE MASTERS

CEE, I wish I could light a subject of the way," as an expression one often hears from aniature workers as they raphers. The fact is that the difference between professional and amateur lighting is largely a matter of volume, although sole factors must be taken into consideration, such as a difference in subjects and make-up, the fact that professional lighting results are frequently aided by after-work on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and a difference on the part of the retoucher, and that available to the amateur worker.

to the amateur work.

Acting on the suggestion of Norman A Schuele, an enthusiastic amateur photog rapher and Advertising Manager of Revere Copper and Brass, Inc., we recently interviewed Bruno of Hollywood, and then retired to our own modest studio to see what could be done about it. Bruno, as you may know, is a specialist in the art of mover



Virginia Wilson

By Bruno of Hollywood

glamor In his studio in New York, he is known as the man who makes them "look like Hollywood" even when they "come in looking like New York". He achieved his national reputation while in Hollywood, where he made a specialty of photographing stars and would-be stars. The technique that he employed in this work he brought with him to New York

Mr Bruno has been kind enough to permit reproduction of two of his pictures as examples of the "straight" and the "glamor" techniques he employs. The picture of Lorraino ('Day is an example of the first, and that of Virginia Wilson, of the second. The latter had the simplest lighting: a 1000-watt spotlight directly overhead and a 1000-watt.

diffused floodlight far back in the room The distance of this latter light must be adjusted to provide just that amount of light that will suitably fill up the shadows without interfering with the lighting effect provided by the spotlight. An approximation that may be employed by the average worker is shown in our illustration, in which a Photoflood type spotlight was used overhead and a No 1 Photoflood bulb in a Kodaffector set back of the camera at an angle of about 30 degrees to the subject. Little attempt was made to duplicate the Bruno picture except as to light placement. Since it is not usually practical for the amateur to use a spotlight directly over the subject, the spotlight used was directed overhead as nearly as possible

The Lorraine O'Day portrait was lighted in considerably more complicated fashion Two 1000 watt flood bulbs were placed six feet from the subject at an angle of 45 degrees to the latter and eight feet high A 1000 watt floodlight was placed at the same angle on the other side of the face but lower and twelve fret away A 1000-watt spotlight was used for the head and a 2000-watt spotlight illuminated the background. In our example, we substituted two No 1 Photofloods for the light six feet from the subject, but because an eight-foot extension was not available we used one about 61/2 feet high. For the shadow side light 10 feet away from the subject, we used a No 1 Photoflood A Photoflood-type spotlight was used instead of the 1000-watt spot used by Mr Bruno and for the background we used a No 1 Photoflood illuminating a monkscloth background

An exact reproduction of the lighting as seen in the print cannot, of course, be claimed for our examples, because, in addition to the necessarily more efficient light-



Virginia Wilson lighting

ing units of the professional, there is also the factor that the professional's prints were de by contact instead of the enlarging method usually employed by amateur workers these days, and also because the professional's prints must usually be retouched. at least in a moderate way

Our thesis, however, is based on the fact that, although necessarily modified because of difference in lighting equipment, the amateur worker may copy the lightings of the professionals and successfully achieve



Lorraine O'Day By Bruno of Hollywood

the lighting effects of the latter Chiefly. it is a case of light placement and light volume Professional lighting effects can be studied and the various lights identified by studying the shadows cast by the subject's nose, lower lip, chin, and so on Practice of this kind will help you to arrange your lightings and to achieve satisfactory illu mination of your subjects

DENTISTS AND PHOTOGRAPHY

THE part played by photography in the professional as well as the lessure life of the dentist was surveyed in the March issue of Dental Survey, in which it is stated that "thousands of dentists are numbered among the most enthusiastic camera fans to be found anywhere

"Photography has a particular appeal for the dentist," the article says, "for through it he can make a hobby serve him as a tool in his daily work. Pictures can be used to the greatest advantage in patient education as a simple, effective means of showing the importance of dental care. Projection of alides brings home lessons that the dentist can never inculcate by demonstration or word of mouth The patient's own case can be personalized in a way that wins him at once to the necessity of adequate treatment

"One dentist has made an album of 'before-and-after' pictures which he uses to demonstrate to patients what different types of restorations will do for them by the improvement that has been accomplished for

other patients. "Color photography has recently come into its own and now enables dentist photegraphers to achieve even more remarkable results. With the still camera it gives them the most accurate record of the stages of their important cases. The method of treat-



Lorraine O'Day lighting

ment can be followed with the motion pic ture camera, operated by an assistant, and in the class room, at clinics and dental meetings, motion picture photography in color helps spread undergraduate and post graduate education by demonstrating in practice what has already been studied in

APARTMENT HOUSE DARKBOOMS

THE vogue that started in New York City some time ago of providing apart ment house tenants with community darkoom facilities has gained considerable headway The latest innovation is the provision of fully equipped darkrooms for the East Side apartment house dwellers living in the buildings owned by the Tishman Realty & Construction Company
"Each building," The Foto Review re

ports, "will be equipped with a spacious darkroom designed to appeal to both be ginners and advanced amateurs. The room, mechanically ventilated, will be supplied with modern equipment including stainless steel sinks, two enlargers, printing machines. developing tanks and trays, safe-lights. timers, trimmers, scales, and graduates to assist in the production of good photo-

Avoid Ridicule

F some amateur does poor work because he cannot do better just yet, be chary of ridiculing him, he may outstrip you later In any event, there is neither charity nor good taste in making fun of the work of one's associates in the camera hobby Yet it has come to our attention that in at least one club the pictures of one worker were laughed at when exhibited to the club members, to the great discomfort of the worker concerned. One member, not the victim, was so upset by this attitude of the club members that he resigned. What if his turn should come next?

There is no doubt that a general club is bound to have a number of members who are rank beginners and turn out what may appear to be astonishingly poor stuff when compared with the work of the more advanced members. However, the advanced members need only look back a few years and recall how bad their first efforts were

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With this Kodak Monitor's swift lens at your fingertips, you get splended snapshots on clear days, surprisingly good ones even under adverse light conditions. Because your 1/400-second Supermatic shutter "stops" most action, you can snap people when they're on the go, get pictures so informal and spontaneous that they fairly live

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fundamental requirements. Once you find out how your camera works, learn how to make correct exposures, and matter the basis of composition, your camera results will show immediate improvement. You need not wade through text books, dry restutes, in order to obtain this information. Into "So You in photography, has packed just the things you need to know. Questions and problems have been anticipated, answered in detail, for the camera owner who has his developing and printing done at the photo shops. Written as a running story of your camera and how best to use it.

Chapter Summary: What Your Camera Does; Equipment for Better Photography; Indoor and Outdoor Pictures, Portraits, Action Photography; Candid Pictures, Angle Photography; Color; Tricks with Your Camera, Troubles and How to Overcome Them.

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SAMUEL E LESSER, New York, submits what he believes to be a new idea in picture making and picture collecting He writes:

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PICTURES AT THE CIRCUS

THE availability of extreme speed films makes indoor creus shots mee feasible than formerly. It is now possible, under solidaying effects, to shoot as finat as 1/100 and 1/200 of a second at 1/35 or 1/45. The accompanying illustrations were made with an 1/29 lens wide open at 1/200 of a second, although the results showed that a higher shouter spee of or smaller lens. The exposures were made about 50 feet away from the camera and the wanted section enlarged to 8 by 10

that the government of the property of the property of the array of acophate "flying" through the array of nound a handrag in the fact that the spoilights were turned off during the action, doubless in order not to handrage the performer, and turned on again when the subject reached the other aide off course, such subjects have to be left done because there is not causaly light available during the flight to make an exposure possible at the short shatter speed

Many subjects do not require fast exposures, however, and may be taken as slow as 1/25 and 1/50 of a second Also, even fast action may be "stopped" if the shot is made just as the subject reaches his objective or when he is momentarily suspended



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"Mid-Air Stunting"

in space before coming down again. This calls for careful watching and quick shooting The shot of the acrobat in the five-man somersault, for example, was made just as the subject reached the shoulders of the fourth man in the "human ladder," after jumping from the spring board below. The shutter speed was 1/200 (the fastest the camera possessed). If a faster shutter speed



"Five-Man Somersault"

were available, 1/500 would have been attempted as the man was flying up, although 1/1000 would probably be necessary.

Pictures such as "Watching the Prev." which shows a tight rope walker performing while news photographers sit around waiting for an opportunity to make a startling shot, may be had at 1/50 of a second and even slower

KODAK AT 1940 FAIR

ESTIMATING a total attendance of nearly four million visitors during the World's Fair in 1939, the Eastman Kodak Company has announced extensive improvements on their Fair Building for this year that are expected to attract an even greater attendance, according to Kodak officials. Among the changes are a complete new front and an enlarged entrance foyer to the Great Hall of Color: a special salon in the Hall of Light for the continuous and elabo-





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rate presentation of the Kodak style show; "startling tricks in photography, along with other thrilling demonstrations" to be presented during the fashion show intermissions, the addition of two model living rooms in one of which will be projected full color home movies and in the other "still" pictures in natural color, changes in the photographic gardens, as well as other improvements

CAMERA CLUBS GROW

AT last we have been able to obtain a figure closely approximating the num ber of camera clubs in this country. After an extensive survey, the Eastman Kodak to 9000 Adrian TerLouw, who kindly passed this information on to us, added however, that this was only the known total and that the actual number exceeded this considerably Clubs are springing up all the time and many active groups do not announce themselves as clubs, preferring to remain "incognito"

NEW BACKGROUND CLOTH

PHOTOGRAPHICALLY useful mate rials are frequently to be found in other than strictly photographic stores, as our readers have doubtless found out for themselves from time to time and as we have occasionally intimated by announce ments in these columns. One of our latest finds is a cloth material known as Incawhich we understand is being widely used by professional photographers where large backgrounds are required. This material, the color of which is a light tan or cream, comes 9 feet (108 inches) wide and sells for unly \$1.75 a yard

TECHNICAL ADVISER

FORMERLY instructor at the New York Institute of Photography, with many years of both professional and teaching ex perience, Morris Germain, ARPS has been appointed Technical Adviser for the Penn Camera Exchange, New York City Mr Germain's task is to assist the store's customers in their photographic problems and in the use of equipment

One of the features of Mr Germain's association with the store is a series of talks



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r Amateur Photographers

New WAYS IN PHOTOGRAPHY, by Jacob Deschin. Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur in one way or another. It covers the whole range of amateur photography, discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner. \$2.85.

So You WANT TO TAKE BETTER PICTURES, by A. P. Peck. A friendly, face-to-face chat with the camera owner who has his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to utilize it to best advantage, Over 200 pages, dozens of illustrations, \$2.10

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AMATEUR FILM MAKING, by George H. Sewell, ARPS Useful to the begin-ner as well as the expert movie maker Tells about films, cameras, exposur film editing, story telling with the camera, and so on, Illustrated \$1.60,

CHAMPLIN ON FINE GRAIN, by Harry Champlin, A complete hand-book on the entire subject of fine grain, in cluding formulas and how pound and use them. \$1.85.

PHOTOGRAPHIC HINTS AND GARGETS, by Fraprie and Jordan How to make all kinds of photographic accessories, from film clips to cameras to lighting equipment, and so on , 250 articles and nearly 500 illustrations. \$3.60.

PORTRAIT PHOTOGRAPHY, by H. Willhams, Fundamental principles of composition and lighting, paving the way to satisfactory results in this particular branch of photography. \$4.35.

PHOTOGRAPHIC ENLARCING, by Franklin I Jordan, F. R P S One of the most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salon-winners, show the value of correct technique. \$3.60

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BOOKS BOOKS on various phases of photography. The opening gui was fired re-cruit when Mr. Germain gave a talk on the fundamentals of laghting in photography. An index of the popularity and helpfuliness of Mr. Germain's talk is the fact that the lecture had to be repeated a week later to accommodate the worflow of visitors who had to be turned away the first time for lack of space. The accompanying illustration shows a viction of the audience, as inducted by Mr. Germain's a viction of the audience, as inducted by Mr. Germain's constitution of the same o

WHAT'S NEW

In Photographic Equipment

If you are interested in any of the stems of described below, and cannot find them up our advertising column or at your photo graphic dealer, we shall be glad to tall you where you can get them Please tend a stamped smelpe with your request

Duo Spot-Flash Adapter (\$6.95). Designed to fit most makes of synchro nized flash equipment, for exclusive use of G E. No 5 flash bulb ("Mighty Midget") in directed flash photography Supplied with removable ring. With ring in reflector, angle of light is 50 degrees and claim is made that ordinary flash exposures can be achieved at about same speeds and apertures ordinarily used with larger standard bulbs such as G.E. No. 21 and Wabash Super-flash No. 2. With diffuser ring removed, pictures can be made at distances up to 100 feet or more Spotlighting possible because adapter is designed to use all available light as directed beam rather than normal flood. Reflector designed to protect beam of light having approximately 30degrees spread Diffuser ring redirects part of beam over wider angle of approximately 50 degrees

KALMAT CONCENTRATION REPORTED (1819). The West type concentrating reflector designed for use with mix midges beyone base flash bulbs. Furnished complete with builtan ejector. Said to double high efficiency of buble Goude stem keeps reflector in cortect position so that light efficiency directed. Reflector made of spin aluminum with highly poliched reflection and the support of t

PERFORATED PAPER ENVILORS Defender now packaging all photographic papers in new, case opening envelope. Envelopes made with double perforation across flap of envelope mere rip and tear gives quick acress to contents. Perforated opener available in all sizes up to and including 11 by 14 mohes.

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Anonix Tanx Less Right Campa (\$45, complex with ballot carrying step), all bather carrying case \$5, cvtrait Tak. 12 meture sees 21, 221, and become standard Bespiesar fold bewing lens and physics lens admiral 75mm /415 triple anastigman, color corrected shatter speeds from 1/10 to 1, 200 of a seen land in the analytic Built in similated Direct vision binder for cvt level action Highly beliefed first variation color correction mirror.

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Burnos Fursia Sperintert (3.7%), Judie extra, 85 cents). Housing model of Bakdite. Stand of beavy cast metal, equipped with four rubber logs, and tripod attachment. Head removable from base, can be used sparately. More height required, can be used with light stand or tripod. Optical system consists of two mich Fresend lens with eviluational diffusing glassian admissible mount with lightly published.

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- Q. I have been fooling with depth of focus indicators and find my calculations at variance with all the cameras I have tried. Is there some difference in the apread of a scale for a camera lens from that of a thus lens of the same food length?—I M. P.
- of the same focal length?—J. M. P.
 A. By "hyprad of a scale" we presume
 you mean depth of field for any given leas
 stop and object distance. The depth of
 field is dependent on the circle of confusion
 or the degree of definition, as you know
 from your calculations, on the focal length
 of the lens—in the greater this, in the shall
 lower the field, on the sure of the lens atop

 [Lens thickness or thus news to mak a factor.
- Q. What is "metol-poisoning," its symptoms, and how may it be prevented? How effective is colored cellophane as filtering material?—T. R.
- A A skin irritation experienced by some photographic workers when handling solutions containing metol or a similar chemcal. Local irritation and cracking of the skin are the symptoms. Washing linade with soap and warm water after handling chemicals and solutions, and the wearing chemicals and solutions, and the wearing it is asid, however, that not more than 1 out of 500 persons experience trouble from this source. Colored cellophane might be used as filtering material over light sources but no tat divide for use over the lens
- Q. For some time I have been interested in casting plaques in high relief in plaster. Is there a practical photo relief method?—W. L. H.
- A. A method of photo relief practiced by a Professor Namias and described by Wall, in his "Dictionary of Photography" follows, "An ounce of fine gelatine is soaked in 31/2 ounces of water, and the vessel is heated in a water bath until all is dissolved, after which I fluid drachm of glycerin is stirred in. The mixture, having been strained through fine muslin, is poured on leveled glass or metal plates, l fluid drachm being allowed for three square inches of surface. When dry the coated plates may be kept any length of time, and sensitizing is performed by soaking a plate for 15 minutes in a 6 percent solution of ammonium bichromate, and drying in the dark. Exposure under a negative in the printing frame should be continued suf-

- hereally long to give a fully detailed image in hows, the time required being about the same as would be involved in making a pirit on ordinary pintout paper. On soaking the exposed plate in water the relief is produced, and the plane can be modified with plaster or with a waxy composition upon which an electropy is made. If the well-of relief he very gently heared in their is such a redistribution of the gelatin as makes the rehef persist after the gelatin sextumes as the results.
- Q. I would like to know where to obtain data on the printing of color films suitable for submission to magazines. Any information you have available as to the type of print suitable for printed reproduction will be appreciated.—L. B. K.
- A Magazones will accept Kodachrome and Dafsycolor transparences from minia ture axize up for purposes of reproduction As you know, in both instances processing as done by the makers of the films, in the case of Dufsycolor this may be done by the photographer Kenth Henney's book, "Color Photography for the Amsteur," describes the various methods of color printing and the recently published "Photography and the recently published "Photography as outstands" by Faul Onter-Indige, an outstands in the color of th
- Q I tred developing my first roll of lim in a tank and found only one negative came out. This negative was in the middle. The one at the heginning of the roll were completely clear of any sign of pictures while the ones at the end of the roll had signs of appearing. Also, when I am prutting, a patch of brown appears on about 90 percent of my prints. Could you tell me the cause and the correction?—
- A Undoubtedly, the blanks on your roll of film were due to extreme underexposure, or tailure of the shutter to operate The ones at the end of the roll had evidently received a brief exposure but too short to provide a useful image.

The brown patches may be caused, among other things, by dirty dishes or measures, or improper fixing In the latter instance, this may be due to failure to keep prints moving in the fixer and to keep them sub-merged in the bath



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A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

THE opening part of the account which follows will be found on page 347, the purpose in dividing it between two parts of the magazine being to present there only the general details of the Goethe Link servatory, such as are likely to interest all the magazine's readers, reserving the more technical parts for special followers of the telescope makers' department The author of the present account, Victor E. Maier (1306 Parker Ave., Indianapolis, Ind.), is known to amateur telescope makers everywhere, for he has long been active in the hobby The 36" Goethe Link reflector is believed to be the largest telescope built by amateurs since this magazine gave an ancient but nearly extinct hobby its renaissance in 1926 by publishing an instruction book. The old lines between amateur and professional telescope makers have largely dissolved Nearly all the great professionals were men who started small and, generally working by themselves, simply developed the art through character. perseverence, tenacity Few had much help Many amateurs among the thousands

who had followed the bolish have now learned to delarge work equally well and through the same approach. The professional, who works at it all the time, can beat the advanced annieur in speed. Some ameteurs, because they do not have to make their livings through the work, can afford to take more time, and thus have done better work, than some professionals. The description by V. E. Maer continues.

"The observatory stands on a high promontory 25 miles southwest of Indianapols, near the small village of Brooklyn From it the Indiana terrain is visible for 40 miles. The build

ing is framed of oak posts and beams cut from the forests not far distant. 13 tons of steel beams were also used in construction, are welding being employed wherever possible.

The designers of the observatory and its equipment have sought to include the gether with as many innovations as could be used profitably. The design of the building itself was inspired by Russell W Porter, who generously sent one of his famous thumbnail sketches to Indianapolis Details were drawn up by A. F. Pittman, an Indianapolis "TN". The larger hemis pherical dome, 34 feet in diameter, is framed of wood fastened to a 12" I brain dome ring It rolls on tapered roller bearings. and is driven with an endless cable fitted with a unique shock-absorbing device. The 34-ton dome is rotated adequately by a 1/2 h.p. electric motor The broad slot open ing, nearly three times as wide as the murror, permuts easy manipulation between the dome and the telescope. The zenith The shutters weigh one ton each, and are activated by push buttons and a 1/4 h p. motor. Dome and shutters are covered with interlocking sheets of steel terneplate and aluminum paint.

"The 35" Goethe Link reflector has several features that are thought to be new The concrete puer was poured before the building was erected. It is anchored to bed rock to prevent whration or future measurement. The steel bearing hoxes for the polar axis are hedded directly in the concrete, making the pier a direct part of the telescope mounting. The pier was breaked with a transat instrument at frequent intervals during the pouring operation, and though its top is 30" above the ground level, it has since been found to position. The bearings have an adjustment of ½". The pier, with 8" reinforced concrete walls, as bollow inside, and this provides a "trong box" on the first floor of the observatory.

"The polar axis is made of arc-welded steel plate instead of the usual castings



Figure 1 The telescope drive in its box

Two sectors were cut from a flat plate and rolled into cones These are internally braced with fins welded in at the points of greatest stress. The larger ends of the cones are bolted to a cube of nickel-steel, through which the declination axis passes at right angles The unit is free from flexure and has five times the necessary strength Each end is fitted with an 8". Timken high-precision, tapered roller bearing The 2000-pound counterweight is rigidly attached to the polar axis. The saddle, in which the optical tube rests, is a standard 18" channel braced with a number of small fins welded in to make it rigid. The declination axis is a standard steel tube that permits the projection of the Cassegrain cone through it. The Cassegrain image may be observed only 2' from the center of rotation.

"Movement of the telescope is accomplished entirely by electric motors. These drive two large gears that contain some new ideas. The right ascension gear has a bronze tire shrunk on an iron center It is 50° in diameter and has 400 worm teeth cut in the bronze. The 48° declina ton gear is made from the same pattern, but has a ring of internal teeth bolted to its side. The outside of this gear is machined and marked with a setting circle Circles and gears are combined in the same piece. The declination gear is driven



Figure 2 Upper end of the tube

by two 1, 20 h p motors working in unison and driving four pinions mounted in the stationary counterweight

The glass enclosed drive (Figure 1) which controls the telescope in right ascension is simple, quiet, and all in one compact unit Exposures of an hour at the 15" focus have been made, with no noticeable drift of the star from the cross hairs Worm gears are used throughout, to attain quietness A 1/12 hp synchronous motor, shown at the right in this figure, drives the 50" R A gear (part of which shows at the extreme top in the illustration) through a differential and four reductions-8 to 1. which is built in the synchronous motor, 16 to 1, 50½ to 1, and 400 to 1 at the large worm gear-to gain the sidereal rate The small motor (center) turns the differential box in either direction and at any required speed, but when the differential is stationary the telescope does not noticeably depart from the ideal clock The differential is used only when special rates are desirable, such as exposing star trail checking plates or guiding on some object that does not have the sidereal rate.

"The motor shown at the left in Figure 1 is a "ki ph. jih speed setting motor which is thrown in and out of engagement by an automatic electric clutch located in front of it. The whole driving assembly was designed by C. D. Turner, V. E. Maier and A. F. Pittman Dual controls are mounted on the floor of the observatory and on the observing platform. The accuracy of the observing platform in the form of the observation of the observat



Figure 3. Looking down the tube

The use of multiple thread worms seems to be a new idea—at least it was evolved independently in Indianapolis Through a suitable choice of ratios, the clock rate was lengthened 25 seconds per sidereal day to compensate for atmospheric refraction.

"The control panel, shown in the central illustration on page 347, has three knobs which control R A., Dec., and dome movements The variable speed, reversible, ments The variable speed, reversible, motors are controlled by rheostats driven by the control knobs. These enable the operator to set the telescope at high speed or to give it just a touch over a small angle There are no manual locking devices, and the rhoostats make it impossible to start the instrument with a jerk or to subject it to undue stresses

The optical tube (Figures 2 and 3) is made entirely of Lynite, Alclad, and Zeppelin Tube-all aluminum alloys The tube contains over 500 pieces, all drawn together by an ingenious arrangement of tension struts. Flexure has been adjusted out of the tube by adjusting the tension at the proper points. The chief advantage of the Lynite tube is its mobility and free dom from bulkiness Inertia and momentum are reduced to a minimum and the drive consequently can handle it much more smoothly. Had it not been for the many weight-saving devices incorporated in the instrument, its moving weight would have been more than double its present value-5200 pounds All the accessory parts are made of aluminum or stainless steel, to eliminate troublesome rust which tends to occur in an unheated dome. The accessories, as well as the mounting, were all made by C D. Turner.

"Figure 2 also shows the upper end of the telescope, with the plateholder used at the prime focus. The upper section of the tube rotates on adjustable Torrington needle bearings shown in the same figure and the Newtonian plateholder can be turned to any convenient position. Guide stars are sent to the small telescope mounted on the rim of the tube. The double-slide plateholder makes guiding convenient and simple. This device is to have a comacorrector installed, at the suggestion of Dr. Harlow Shapley, to flatten the field over the 4x5 plate. Figure 3 also shows a view down the tube. The curved sheet just above the aluminized mirror surface is a stainless steel cover which curves to the inside of the tube when it is raised, and straightens out again when it is lowered on the mirror cell. The cover has a chamois skin gasket. A tiny spot in the center



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of the mirror is paint, applied to aid in collimation. The prime-focus plateholder can be seen reflected from the mirror's surface.

"Another piece of equipment that is different is the observation platform of the larger dome (Figure 4). Its design was evolved chiefly from Dr E F Carpenter's platform at Steward Observatory, Tueson, Arizona The chief difference lies in the



Figure 4 The observation platform

method of supporting the load. This platform, which has a capacity of six persons, is supported by two long steel arches which span the inside of the dome on either side of the shutter opening. They stand on the dome's steel base ring, and are also strong enough to contribute to the support of the dome's wooden superstructure The wooden platform floor is suspended from two straight tracks welded, like chords, to the arches at the correct incline The plat form, with its rollers, is pulled up and down these tracks by steel cables and a h p motor. The hoisting mechanism is mounted in the upper part of the dome. back of the opening. The dead weight of the platform is relieved from the hoisting mechanism by a counterweight on the op posite half of the steel arches. The entire assembly is independent of the dome and would operate as well if it were standing by itself. It allows access to any point reached by the upper end of the telescope There are no blind spots with this instrument. The switches and wires at the right, in Figure 4, operate the dome, platform and telescope There are no wires on the telescope tube

"The second, or small, dome (Figure 5) houses a 5" Zeiss triplet apochromatic re fractor that matches the performance of instruments many times its size. This telescope has a full complement of accessories, including those for solar work. The smaller dome is made in two halves, so that much of the sky may be seen at one time. One half is just an inch smaller in radius than the other This dome is framed of steel channels rolled to radius and welded into place The inside of the dome is covered with Sprayoflake, a patent heat insulator, sprayed on with a hose This keeps the interior comfortable during hot summer days

"Except for the study room, which is well musulated and is heated electrically, the observatory building is not heated. It has its own water system and fire protection. The interior has hardwood floors, panelled knotty pine walls, and beamed ceilings. A spiral starticase leads to the large dome and telescope, and a smaller stair to the other dome.

"The administration of the observatory has been invested in a non-profit corporation

called the Gesthe and Helen Link Founds ton for Soratific Research Its purpose is to advance the science of astronomy in the state of Indians. Dr. Link has endowed the observatory with a permanent income. Dr. James Culley, the first astronomer from Indiana University to hold the position of created fellow at the observatory, has reasonable to the control of the co

"The builders of the observatory are indebted to the many members of the sstronomical profession who have aided in its successful completion

"All agree that the spirit of unity and co-operation created by Scientific Amerian's two 'Amateur Ielescope Making' volumes is chiefly re-ponsible for the ex istence of the new Goethe Link Obabout which another 2000 words might be written, a Hartmann test, reduced by Dr. James Cuffey of Indiana University, disclosed a 'Hartmann criterion' of 066 second (Those who have memorized 'the book' will recall that this figure represents the least diameter of the cone of rave, approximately in seconds of arc, reflected from the mirror's surface) This mark is but 0.016 second from the record set on the McDonald mirror Greater accuracy is not necessary. as the inherent diffraction in the instru ment enlarges the apex of the cone to twice this amount even with perfect atmospheric conditions The mirror was aluminized by Leroy M. E. Clausing

"The 8½" by 12" flat also was made by Charles Herman and V. E. Maier."

I N almost no time, after the publication of "ATMA," describing the Richest-Field Telescope which shows the maximum number of stars possible in one field, these



Figure 5. Smaller of the two domes

"RFTa" were being made by the hundreds and everybody was acclaiming them as an extended of these were of 6° size but Figure 6 shows a 12½" RFT; the one nearer the reader, made by 1. F. Simpson, a medical and X ray technician at Garrison General Hospital, Gastonia, North Carolina, and set up on a roof. It is an 1/5 and Singson says it "shows most beautiful star fields, while the Orion nebula is more brill limit than I have ever seen it. When look-

ing at the Moon, it is actually necessary to hold your hat over the mouth of the tube to cut down the superabundant light."

The other telescope, mounted tandem in a long yoke of corner-welded angle iron filled in with two-by-fours, is a 12½° Cas segramian These two make just the right combination for non contortionists the Casegramian higher up and used from below, the Newtonian below and used from



Figure 6 Simpson's new equipment

above. The tube of the RFT turns in the solid trunnion ring shown to place the eye piece wherever most convenient

Simpson formerly had the 12½". Casse granus and an 8" RTF mounted in tandem granus and an 8" RTF mounted in tandem on the same roof (described in the March, 1944), number but each in a fork instead of a voke. This lacked stability, but the double voke afford great stability, be now testifies. Simpson's intention is to link the two tubes together with a roof (detachable whenever descript) so that they will always cover the same field.

OF side interest to "TN's" is a recent improvement in commercial silvering of ordinary looking glass mirrors, developed by Peacock Laboratories, Inc., 54th St. and Paschall Ave, Phil, Pa, a Libby Owens Ford subsidiary Old method was to wash the glass, go over it with tin chloride, wash this off, lay the glass on a heated table and pour on, from a pitcher, the mixed ammonia-silver-nitrate-plus-reducing solution, using 8 oz. per sq ft, and wait 20 to 60 minutes for the coating New method employs a two-nozzle sprav gun Emerging from it in a spray, the two solu tions meet and mix 7" in front of the nozzle, and continue to the glass. The glass is sloped and moves on a conveyor belt, greatly speeding up the work Claims are that I oz. silver nitrate silvers 30 sq ft of glass, showing how wasteful our telescope mirror methods must be - or were before aluminizing took the lead

NEW clubs of amateurs: The Amateur Astronomer's Club, S. Rasmussen, Cor. Sec., 720 Westover Ave., Norfolk, Va Telescope Makers of Central California, Jos. A. Mello, Sec., Suite 222, First Nat'l Bank Bldg., Madera, Calif.



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LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar

ETHYL

THE recent decision of the United States Supreme Court with regard to the licenses for making, using, and selling gashie containing a patentied fluid bearing interactly lead has given rise to considerable newspaper comment. Much of the newspaper publicity implies that the decison is revolutionary in scope and has introduced new principles into our patent laws. Actually the decision is orthodox and is based upon well-established principles. Underlying the decision is of the diameter of the decision of the decision is the foundamental principle that after a patented article is sold in commence by the patentee or his hecease the patentee can no longer exercise any control over the article.

In the decision under consideration the Supreme Court found that the patentee was the owner of patents relating to a gasoline additive containing tetraethyl lead and also to gasoline incorporating the additive. The patentee granted licenses to most of the large oil refining companies in the United States to manufacture, sell, and distribute motor fuel containing the patented fluid The beenses prohibited the refiners from selling the patented fuel to anyone except retail dealers and jobbers beensed by the patentee In addition, the license to the refiners provided that the refiners should maintain certain price differentials in the gasoline embodying the patented fluids

notice in writing.

The Court found that it was an estab lished practice of the patentee to investigate the business ethics of licensed jobbers in order to ascertain whether they maintained the marketing prices, policies, and practices prevailing or ostensibly prevailing in the industry. As a result of its practice of investigating business ethics, coupled with its power to cancel the licenses of refiners and the majority of jobbers be heved that it was necessary for the jobbers to maintain the required business ethics and to maintain prices in order to obtain and retain their licenses From this it was con cluded by the Court that the patentee was exerciaing control over the resale price of the jobbers for gasoline containing the pat-

The Court pointed out that a patentee "may grant licenses to make, use or vend, restrict in point of space or time, or with any other restriction upon the exercise of

the granted privilege, save .nl), that ly statehing a condition to his hereine he may not enlarge his monopoly and thus acquire some other which the statute and the patent together did not give. The Court held that he acrease of the reader pure of the polher of the control of the care that the state pure of the polher of the polher control of the polher of the pol

In reaching its conclusion the Court pointed out that the patente had established 'the marketing of the patented fuel in vast amounts on a nationwide scale through the 11,000 pobbers and at the same time, by the leverage of its licensing contracts resting on the fulcrum of its part in the patent of the patent

STYLE PIRACY

ESIGNERS and creators of original fashions in clothing have made re peated but unsuccessful attempts to pro tect original fashions which are new but do not rise to the dignity of invention and accordingly cannot be protected by patent from style piracy The design and con struction of garments, when they are new and embody invention, may be protreted by patent However, very frequently new designs and fashions in clothing having great commercial ment cannot be protected by patent and within a very short time after the designs are displayed on the market many copies, usually of a less expensive character, appear on the market.

character, appear on the market.

In an attempt to protect designer and creators from copying of the sharacter and designers was organized. The trade association established a registration but reason with any creator of original designs and styles in hats could register the designs. In addition to this more than one thousand retail stores in the United States agreed to cooperate with the trade association by refusing any practice of designs and styles in the state of t

The Federal Trade Commission contended that the concerted action by the hat manufacturers belonging to the trade as-

sociation was a violation of the anti-trust laws and ordered the essuciation to ston further boycotts of retailers and manufacturers who had comed registered designs. The association appealed to the Federal Court and the order of the Commission
was sustained The Court conceded that design or style piracy was an evil that had adverse effects upon the creators of de-However, the Court pointed out that under our law only designs embodying invention were subject to patent protection and that any other design could be copied at will by competitors Since this was the policy of our law, the concerted action of the manufacturers belonging 40 the trade association was held to be a violation of the anti-trust laws

In this connection the court made the following statement

"We believe, therefore, that concerted action to climinate style pursay extends beyond the permissible area of industrial self-regulation. The purpose of the milliners is to maintain their price structure, and to climinate a distasteful evil which the law newrtheless recognizes to be a socially desirable form of competition."

DIAZO-TYPES

PATENTS relating to chemical compositions and processes present a peculiar difficulty not encountered in connection with patents for other types of subject matter. Thus where an inventor employs, in a chemical composition or process, a specific element such as chlorine, he naturally does not wish to be limited in his patent to that particular ingredient. In an attempt to make his patent as broad as possible he might state that the entire halogen group of materials may be employed If it should later appear that one or more of the halogen materials are inoperative in the process or composition then all of the claims of the patent specifying the use of halogens are invalid and only those claims limited specifically to chlorine are valid

An example of this principle is cont in a recent case decided by a Federal Circut Court of Appeals relating to a patent for photo sensitive copy papers known as diazo-types, used in reproducing engineering drawings. The patent stated that the paper should be coated with two materials, one of which was stated to be "a diazo compound being formed with amino compounds containing at least one other amino group" The patent contained both product and process claims, each of which specify the use of the above material. At the trial of the case it was proved that not all diamo compounds of this character would operate but only those containing a quinonoid or anhydride structure. As a result of this evidence the Court concluded that the claims were too broad and covered materials which would not operate and accordingly were invalid. The principle of law lowing manner

"Where within a general classification disclosed by the claims, are compounds which do not answer the description of the specification, even though there be a general quality common to them all, yet if there be no common quality in respect to their effectiveness in achieving the inventive concept, claims for their exclusive use cannot be sustained."

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IN the article starting on page 5 of this issue is given a compact survey of the world's finest warplanes—those employed by the Air Services of the United States. On our cover is illustrated the North American observation plane, O47A Note the vindows in the lower part of the fusel-age and the full-instance ockyli reclosure. The eyes of the Army must see all - Official Photograph, U. S Arms Air Corps

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SCIENTIFIC AMERICAN, July, 1940. Vol. 153 No. 1 entered at the New York N. Y. Fost Office as second class matter June 25, 1879, under the act of March Jrd, 1879, additional entry at Grance, Comm. Published monthly by Munn. a Commany Inc., 24 West 40th Street, New York Oily. Copprehabed 1940 FY Munn. a Company. Inc. Oreal Britishn rights entered Subscription price 14 00 per year. Canada 14 50 Foreign 85 00 Manuscripts are submitted at the satisfar's rate and cannot be returned unless accompanied by postage.

50 Years Ago in . . .



(Condensed From Issues of July 1890)

CANAL. "It is now over tight years since work was first begun upon the Panama Canal, and about two years have elapsed since active operations were suspended. The total cost of the work up to the present time, including the indebtedness of the company, is estimated at seven hundred millions of dollars, and the canal is hearth, half finished."

CRUISER—"The squadron of evolution sent by the linited States government to the Mediterranteen, under commercial government to the Wediterranteen, under community and the squadron was the fragge constructed of mild steel, at a cost of about one milion dollars, and launched in 1825 bits vs 33 ft ft mon. 48 ft broad and draws 19 ft having a displace-



ment of 4,500 tons. She has two screw-propellers, with engines of 5,500 horse power, indicated, the machinery is protected by a 5,000 horse power, indicated, the fact of 15 knots an hour, and she carries 940 tons of coal. The armanent consists of four 8 in breek hoading guns on the 5,000 and feek, eight of in breech hoading guns, in broad-side, on the gun deck. and two 5 in breech loading guns aft, with a transfer and the 5 in breech loading guns aft, with a transfer guns.

GUNPOWDER.—"No evidence exists of the use of gunpowder as an agent of warfare until the indidle of the twelfth century, nor did a knowledge of its propulsive effects come to the Chinese until the reign of Yunglop in the lifteenth century at thousand years after us first employment in fire crackers.

GLASS.—"A new method of obtaining stained glass is done by a process of printing. The design is embosed on a tron plate, on which a lump of hot glass is rolled until it takes the form of the plate on which the pattern is cast. The sunkes lines are then filled with enamed and the whole plate is fired. This process obviously does away with the use of leads, is rapid on its execution, and has the additional advantage that the design may be repeated as often as it may be required.

TOOTHPICKS "Quilt toothpocks come from France. The largest factory in the world is near Paris, where there is an annual product of 20,000,000 quils. The factory was started to make quilt pens, but when these went out of general use, it was converted into a toothpick mill.

GIRDER—"The Keystone Bridge Co has just completed a girder for the new City Hall of San Francisco, which is the largest ever made in the United Nates. It is 105 feet long, and weighs 70 tons. A contract for two girders was given to the company list November, and they have been working on it ever since. The materials for the second one are now being prepared. The girders are intended for the ground floor of the building.

WELDING.—The great demand for artificial ric machines, and the necessity for furnishing long coals of pipe to be used in their construction, has furnished a new and extensive field for the pipe welding mechanises of the Thomose Electric Welding Company. The difficulty of welding pipe by the old methods is that, sulcess the points are perfect, there is an ecape of ammonia vapor what renders them practically useless. It is found that by the electric welding process here joint are perfect, and lengths of 400 of 500 effect of homogeneous pipe can be made without difficulty. The electric welds stand bending rether how or cold?

FOOD "Probable to modern science presents a woder field for speculation than that of chemistry, and more separally, perhaps, that brain h of the science which treats of organic compounds in an address delivered at Heiseldberg, but one see seminert an authority than Victor Meyer, it is amounted that 'we may reasonably hope that chemistry will reach us to make the fifter of swody all be found if this becomes possible, in this would off our forestation of the control of the seed of the control of the control of the conories in great section.

PAYTELPHONF "A novel telephone station is being introduced in Connection II, miteriument cannot be used unless a few is paid. There are five slots in the machine for the reception of a nockel, ten cent purce, quarter, half dollar, and dollar respectives by To use the relephone it is first necessary to call up the central, as on an ordinary telephone. The objective point is then asked for, and when this is reached, the party who rings up is told to put the occessary few in the slots."

SPEED.—"A special train on the 15th July left Baltimore at noon, and thrity-five minutes later had traveled forty-two miles and was in the Pennsylvania railroad station in Washington. The speed averaged 72 miles an hour, or allowing for starting and stooping, at least 80 miles for the greater part of the run.

AND NOW FOR THE FUTURE

¶ Progress in the young and vigorous organic chemical industry. By Dr. C. M. A. Stein

¶ Geriatrics -- the newest medical specialty By Barclay
Moon Newman.

¶ Pattee's Caves, where medieval Irish monks may have lived in New England. By Prof. Hugh O'Neill Mancken

¶ Evolution in the future: Will the human species ultimately produce a race of super-men? By Henry M. Lewis, Jr

¶ Brilliant achievement in the improvement of commonplace textiles. By Philip H. Smith.

Personalities in Industry

BORN in Brooklyn, New York, in 1892. Donald W Donglas was 11 years old when the Wright Brothers made their first flight at Kitty Hawk. Six years later he received his appointment as a midshipman in the United States Navy and was ordered to report to Annapolis. In 1909 the two American meetitors of the flying machine brought their frail hiplane to Fort Mever, Virgina, for a demonstration to the United States. Army Young Douglas was among the few who saw the airplane leave the ground, for a demonstration to the United States Army Young Douglas was and return to stating point the did not know at them but that event also marked the beginning of his career.

After three years of training cruses. navigation, and mathematics, young Douglas still had his mind on wings and skies instead of the seven seas, and was ready to turn to new, untried fields. His father, William E Douglas, a New York banker, hoped Don would become a naval officer, but fate and Donald decreed otherwise. In 1912 he entered the Massachusetts Institute of Technology. His progress at the Institute was rapid. He was graduated in 1914 and in June of the same year received an appointment at that institution as Assistant in Aeronautical Engineering at a salary of \$500 a year. It was his first job in aviation

With Commander J C Hunsaker. young Douglas worked on the first wind tunnel, a step that laid the foundation for the amazing development of aviation in the last quarter of a century In 1915 he joined the Connecticut Aircraft Company in New Haven as a consultant and there worked on the D-1. the first dirigible built for the United States Navy Later in 1915 Douglas went to Glenn L Martin and became his Chief Engineer Within a year he was Chief Designer for the Aviation Section of the Signal Corps, but later returned to Martin. At 25 he was one of the outstanding men in the fascinating new field of aeronautics

By 1920 Donald Douglas was working for bimself He came to southern califorms and with David R. Davis formed the Davis Douglas Co. Their first office was "desk space" in a barber shop. There was designed the Douglas Cloudster, the miracle of its day It was only a step from the Cloudster to a Navy contract for several aiplanes In four years Douglas was ready for



DONALD W. DOUGLAS

another milestone in his career. A new model, the DW t. was finished and the United States Army was on its way to make its historic flight around the world by air. The Douglas slogan hecame "First Around the World," and today is "First Around the World—Now the World Over.

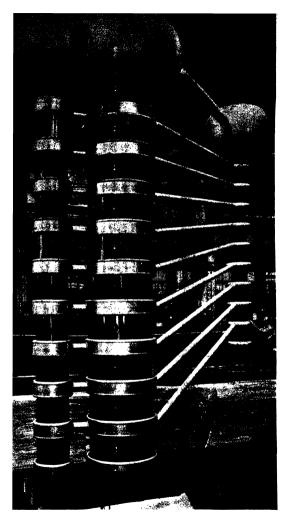
At the age of 32 Donald W Douglas was internationally famous Hie orgamzation grew until today the two
Douglas factores at Santa Monca at El Segundo, California, are America's
largest airplane plants. On May 1
1940. Douglas employed over 17,000
men and women, with a payroll of
approximately 228,000,000 00.

In 1932 Douglas entered a new field. The historic DC I and the DC 2 changed aerual transportation in America. Soon Douglas sirliners were dominating the "DC" series was delivered in May 1940 Douglas sirliners fly more than 350,000 miles every 24 hours in the United States and 22 Greigin countries. To the

safety record of 1939, when the airlines in the United States carried 2,000, 000 passengers 815,000,000 miles without an accident. Douglas contributed equipment for 85 percent of this imposing record.

Universal acclaim and recognition made no change in Don Douglas. In 1936 when President Rossevell presented him the Collier Award for outstanding advance in avaition his associates still called him "Doug," as they did after he received, in January, 1940, the Guggenheim Gold Medal for the outstanding contribution to the development of commercial and military air-planes.

He s married and lives with his wife and children in Santa Monna, close to the huge Douglas plant Reading, saching, and quet hours with a few close friends are his recreasion Never flustered, seldom disturbed, always calm and collected, he continues to keep pace with the amazing progress of the thing closest to his heart—avaiton



THE WORLD'S MOST POWERFUL X-RAY APPARATUS

THREE principal objects in this group are, at right, a 1.400 000-volt X ray tube, in center, a high voltage generator to feed it, at left, resistance units General Electric has built this big apparatus for the National Bureau of Standards, which will use it, first, to explore X ray dosage at the high er voltages into which medicine is pushing, later for producing neutrons and artificial radioactivity for physical research The 1,400,000 volt, 10 milliampere X-ray tube is composed of ten sections of 140,000 volts each in cascade, each section is fed individually by its corresponding section of the ten part generator This is composed of step-up transformers, capacitators, and kenotron rectifier tubes. Resistance units in left hand stack are used in meas uring the voltage X-ray tube is 28½ feet high, and its beam of electrons travels 24 feet In operation these electrons start at zero velocity and are given a velocity kick in each section, so that at the target the speed 18 180,000 miles per secondvery nearly the velocity of light. Curved tops of each stack are spun aluminum corona shields to prevent loss of

A 10 M



Official photograph, U 8 Army Air Corps
A Boeing flying fortress, world's largest service ship, which will be dwarfed by a 72-ton ship now building

America's Winged Weapons

World's Finest Warplanes . . . Built to High Standards and of Superior Material . . . What the Various Types are Designed to Accomplish

By JAMES L. H. PECK

An embittered Spain, a dissunted Poland, and a captulated finland boar mute testimony in potency of modern arraywer, what remains of the modern arraywer, what remains of the Old World appears destined to suffer at the hands of this new weapon—swift-est, most far-reaching of Man's war agencies. And all of this has a very definite effect upon American defense in general and our air arm in anticular in general and our air arm in anticular.

The sleek warplanes, which are literally the sinews of this American air arm. are much in the news these days, current discussion is international as well as national These fighting craft are of several types, each of which is designed for one of the tactical sub-divisions of our Army Air Corps or Naval Air Service The tactical branches of the former include pursuit, attack, observation, and bombardment Naval branches are somewhat similar, and comprise fighter, scout-observation, patrol, and bombing squadrons The small but colorful Marine Corps flying organization is an integral part of the Navy Bureau of Aeronautics, and their equipment is of essentially the same pattern

Fighters and pursuit-interceptors are

the smallest of combat craft, their tactical function entailing the destruction of enemy hombers and combat ships The designation "interceptor" has been applied to American planes only recently, although England has, for many years, employed single- and multiseater planes of this type. Its primary use is to fly up and out to intercept approaching hostile planes. The interceptor is usually designed for extremely fast climbing and is heavily armed Fighters and pursuits are usually more maneuverable, and engage in close and rapid in-fighting while the interceptors indulge in hit-and-run tactics. The new Air Corps pursuit-interceptors are single-seaters, having four machine guns and aerial cannon mounted stationary within the wings or the cowl in front of the pilot's cockpit. The ships are aimed and flown at the target, while the guns are fired automatically by hydraulic or electric devices, the triggers being mounted handily on the ship's control sticks

The much-publicized Bell P-39 "Arracobra" and Vultee "Vanguard" are typical prototypes. The Bell YFM-1 'Airacuda' and Lockheed P.38 are twm-engined craft of somewhat larger dimensions, the former being our only multi sater (twe-man) fighter. The newest models are the Curtiss P.42 and P.46 and the Nav's Brewster F2A-2. All of these sparking craft are superior to any in the world in their respective classes, which is why the Ando French Purchasing Commissions are not exactly unharms.

COMBAT planes are evaluated in terms of their performance—how fast their life at both crusing (with 60 to 75 percent full power) and top speeds, how easily and rapidly they may be maneuvered through the aerobatics oct assumed by combat, and how quickly they can take off and climb to high altitudes to meet the enemy. In addition, they must have a high. "factor of safety" and good flying characteristics in general, with safe landing and take-off abilities in particular.

This behavior, however is but a means to an cell High speed in essential manily for the purpose of overtaking or excaping enemy craft, a rapid rate of climbs, to get the defending planes up to the allitude of the approaching ones; and maneuverability, for the sole purpose of outflying hostile ships so that the guins—"direpower"—may be brought to bear. No warplane is any more effective than its armament, and the successful employment of this, in turn, depends upon the man behind the gui

None of the World War II warplanes

rank so high on all counts as do our new pursuit-interceptors, two of which are some 70 miles faster than any Nazi ship known to be in service, and four of which will climb to 10,000 feet in far less time than Britain's "Spiffire." topmost World War II climber

Planes of the attack branch are designed for assaults on ground troops and materiel in a low-flying operation called "strafing," employing machinegun fire, small and medium-sized bombs (30 to 100 pounds), and contaminating chemicals After using attack planes which were slightly larger than pursuits for several years, the Air Corps has found the 60-foot, twin-engined attack bomber more satisfactory. These "winged tanks" carry more fuel and bombs than the smaller attack plane, and this added gas capacity permits them to accompany larger bombers on a mission far beyond the cruising range of the former type. The two motors make for increased speeds and also provide better forward visibility for the pilot. This is paramount when flying 400 miles per hour at tree-top altitude The new Douglas A-20A almost attains this pursuit plane speed with a full warload of bombs, fuel, and war chemicals. Although this ship, the Martin 167W and North American NA 40A, carry crews of from three to five men, the forward-firing guns, which are mounted in the wings, are fired by the pilot in the same manner as those on a pursuit plane. A rear gunner holds forth in his enclosed turret to ward off

would-be back-biters, and the bombardier bombs from his vantage point in the ship's nose.

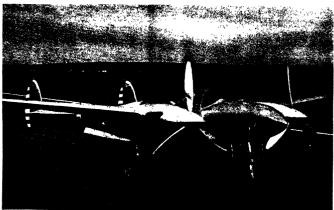
Encamped troops, or those who are marching, are easy prey of attack bombers, and these ships support friendly infantry advances by strafing enemy trenches, artillery, and machine gun emplacements. A most important mission, however, is the support of bombing operations, wherein it becomes the strategy of the attack planes to "neutralize" or destroy the anti-aircraft batteries which protect the objectives sought out by their big brothers, the medium and heavy bombers. The low flying onslaught enables the attack bombers to flash from behind terrain features and trees upon the unsuspecting victims with the element of surprise and blinding speed in their favor. Antiaircraft gunners who are being harassed by parachute bombs and mustard spray are practically helpless for all their marvelous fire-control gear, all of which makes the attack bomber the most deadly thing on wings

THE air raider's tactical function is together together together with the state power and pumping stations, shiping and docks, mills, factories, and other sources of material and food supply, communications and transportation centers, troops and fortifications—most of which are to be found within city limits and necessarily involve the military and the heipless able.

Heavy bombers, such as our Boeing flying fortresses, are designed to carry huge fuel and bomb loads for long distances. A six- or eight-man "combat crew" comprises pilot, co-pilot, bombardier, radioman, navigator, and gunners, most of whom are quite versatile in that they can exchange places and jobs when necessary These types are four-engined monoplanes having machine guns disposed about the huge ship in such a manner as to provide defensive fire from all angles The Air Corp's Douglas B-19, now building, weighs 72 tons and has a cruising range that will permit a round trip flight between New York and Paris

However, not all bombardment missons call for long-distance flying, and because of the poor strategy involved in employing the long range bomber for not so-long operations, the fortress' little brother, the medium bomber, caminto being. This is a twin-engined monoplane which is smaller and faster, and carries less warloud over shorter distances.

Because of the diversification of Navabombers a word is timely regarding the "egg lavers" of the flying fleet. In the of the heavy bomber, the Navy employs a 13-ton patrol bomber of the now amous Consolidated PBY type which gained popularity through the recordheaking formation flights to Hawaii and the Canal Zone sometime ago. These are twin-motored monoplane flying boats. The boats of Patrol Wing Five are conducting the Neutrality, Patrol



Official photograph, U. S. Army Air Corps Rated as the world's fastest pursuit-interceptor, this Lockheed P.38 has two 1150-horsepower engines



Official photograph U S army Air Corps

Note the wing guns in this Martin 167 attack-bomber. Top speed is 355 miles per hour

off the Atlantic coast. These are the aerial cruisers of the fleet, and with their formidable range the PBY boats can five hundreds of miles to spy out enemy ships.

enemy sups.

The torpedo bomber is a single engined, low-wing monoplane of about
gined, low-wing monoplane of about
2000-pound torpedo and are carrier
above the waves, headed strught
for their floating target release the
"fish," then pull up and away before
the explosion occurs

The sout-bombers and dive bombers are smaller—the Curtise SBC.4 "Hell diver" having a 34-foot span—and faster. The social bombers carry on short-distance reconnaissance, and when necessary they stop souting and commence bombing Both these prototypes employ the spectacular vertical dives tack, in which they scream down at around 400 miles per hour, aimed at the target, release their bombs, then pull up when about 500 feet above the sea

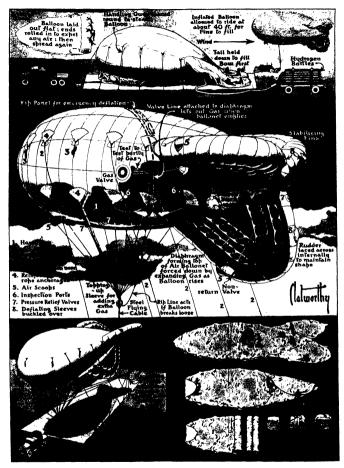
Bombing teams—pilot and bom bardier—of the patrol bombers and the hard Corps types lay their death eggs in a less spectacular method from higher alituteds. When the bombs are released from the racks in which they are suspended in the plane's belly, they do not all straight downward, but travel forward with the ship for a distance before heading earthward in a parabolic trajectory. This behavior—that is, the forward movement from point of reformed movement from point of refo

lease is called "range" and it varies with the plane's speed and altitude From 6000 fect, a bomb would have a range of about a mile and a quarter if the homber is flying 240 miles per hour, at the same speed, the missile would have twice this range-or 11648 feetif dropped from 12,000 feet. But range is only one of many considerations, and all these are neatly taken care of by the bomb sight. The bombardier makes settings to correspond to the plane's speed, altitude, wind drift, ground speed, and other technicalities, and sights down and ahead until the target is lined in the telescopic view finder. then merely presses a button Electrical apparatus and science take care of everything. The miraculous accuracy of our Sperry sight is pretty well known by this time both in and out of the

OBSERVATION work is not so glamorous as that of the combat branches, but it is equally important Aerial reconnaissance-the "eyes of the Intelligence"-is perhaps the most important original source of enemy information available to ground commanders. Flights over the hostile back areas, trenches, and cities, and the photos thereof, supply invaluable information of enemy movements. The North American O-47A, an all-metal, midwing mononlane, which is provided with a windowed belly for the observer and his all-important camera, is the current Air Corps observation plane.

Another unglorified branch which is employed by both the Army and Navy forces bear- the simple title "Utility. but it is most essential to the smooth operations of the air forces Cargo ships fly all sorts of equipment to air bases or outlying posts Transports-which are largely of the Douglas DC-2 type seen at most arrline terminals are necessary for the rapid movement of personnel and staff officers Ambulance craft have saved many a life by swift. comfortable transportation of injured personnel to a place where medical at tention was available. The military version of the Douglas transports employed for these purposes is known as the C-39. Last, but far from least, come the vitally important training craft of "primary and "basic" designations, two of the newer types being the Army's Vultee "Valiant" and the Navy's North American SNJ-2 Fledglings must undergo gradual, carefully supervised transition from these trainers to the speedy, tricky pursuits or giant bombers

These are the world's finest warplanes, they fly sater and farther than
any of the respective foreign types
known to be meruce or building, and
they are built to higher specification
standards and of superior material. Our
services, unlike most of flowe across the
water, believe as a matter of policy that
American airmen are worthy of the
finest airplanes that engineering
genuity and money can provid—and
we have more of both than any country
in the world.



CREW OF TEN HANDLES A LONDON BARRAGE BALLOON

E FFICIENCY of the London balloon barrage has been proved by the unfortunate wrecking of two friendly air-

planes since the war began Such barrages have shown their and is made ready for flying by ten soldiers and a corporal.

OUR POINT OF VIEW

Who Ever Dares Say Never?

IT any tage any longer to assert that anything will "never" become possible. Since a long time ago every senits, has known that you never could expect to see clearly objects has known that you never could expect to see clearly objects that the control of the second of the country of the second o

This permitted you, however, to see most of the disease germs. You could see them alout as clearly as you can see and recognize a man standing off at some distance, with the naked eye, that is, you could see their general outline but not much of their detail. By wholly different methods than seeing, seeinge could, of course, deduce and prove the existence of many things smaller, smaller,

Today, thanks to the electron microscope so lucidly explained on another page by the young physicist, Jean Harrington, we expect soon to behold clearly, not, it is true parts of atoms or even whole atoms, but the entities that stood next higher on the forever forbidden list, that is, viruses and large molecules- the latter have been seen already. The election nucroscope at one jump has multiplied our power to peer into the vastness of the minute just about fifty times, it permits a magnification of 100 000 diameters! It would even permit us to see atoms if certain wide practical discrepancies between its theoretical and actual power did not still bar the way. Won't these "bugs" be disposed of? Some may Yet the men who have wrestled with the problem in the flesh think the electron microscope never can come within five percent of its full theoretical resolving power. Some practical reasons are human mability to attain perfect symmetry of parts, to a de gree way past even fine machine work, tiny residual irregu larities in coil windings, residual ripples in voltage control that cause variations in electron speed, though you control it, as RCA has, within three volts in 70,000, and, finally, the very same hard-boiled family of abertations spherical and the others - that have always bedeviled glass

This super microscope, which is now coming into its furtion stage after about a decade of difficult development, is the result of a combination of strategem with a great deal of invention, experiment, tende to a superiment of technique. Confronted by a blank wall science made a flank movement. Since images of blings far too small to fit the pattern of ordinary light were needed, resort was had to a kind of light having far finer texture—electron waves. Electron waves being invisible to our eyes, they were then transformed, by means of the substances on the fluorescent screen, into waves which our eyes could perceive. These substances can take in the electron energy, change it into light, and send it out again—visibly. And there, on that screen—for example, in the electron mercooper at the Canden labora.

tories of the RCA—you can look into a glass-covered window and, with entire confort—no squinting—see large greenish images of things magnified as man never before looped to see them. If makes you field a bit creepy. Here is a chain of strepto-cort linked together by a narrow wast, like the waistbetween linked sausages. It is molecular in size. Or a typhoid germ with flagglell, like little whips, extending from it.

There are three important things in the biological world which for a long time have greatly annoyed scientists by being just too small to descry clearly in microscopes - the virus, the gene and the bacteriophage. Viruses-known cause of measles, influenza, smallbox, infantile paralysis, vellow fever, and the common cold-have for some years been suspected of being either half alive living things or half alive chemicals Will the electron microscope lead us to a better understanding of viruses and thus to a cure of the virus-caused diseases Second, the gene, that hereditary factor in our cells which determines our physical and other characteristics. Will the new tool enable us to discover new facts that may ultimately make for better animals and plants even human beings? Third the bacteriophage, a sort of predatory germ-the germ s own germ which kills bacteria. Medicine would greatly like to know just what this perplexing entity really is Some scientists think it is as much smaller than a germ as a germ is smaller than an amocha

Finally, the electron microscope promises much of wealthcontrolling value for industry. Probably there is no industry, using any kind of material that will not ultimately profit by the deeper insight into the real nature of the materials it uses which the electron incrossespe is expected to provide. Examples are the rubber industry trubber's complex molecules), the crement undistry the paint industry, and the coiloudal notals' industry. Laboratory workers equipped with this new instrument can not interely count the number of particles of a given material, as has long been possible by ordinary optical introcoscopes and ultra microsopes (which do not, however, resolve them into clear images), but now can actually see their all important size, shape, and especialls their uniformity or variety. Industry already is awake to this new implement. Some companies, the Eastman Kodak Company, for example

are already using electron microscopes of their own design It cannot be said yet, and it may never be true, that the election microscope will be accessible easily to every man who would like to have one around home just to amuse himself. The instrument now placed on the market by RCA costs, with its 100 kv regulated voltage supply, \$17 500 It weighs 700 pounds and stands ceiling high, it is no portable vest pocket apparatus. Nor could the average man use one without special training, for it would be about as difficult for him to steer as a temperamental wife. The thing examined must first be placed on a film of nitro-cellulose only 1/3,000,000 inch thick --literally next to nothing! Air must be evacuated from the whole interior, because the big atoms and molecules in it otherwise would obstruct the flying electrons and alter their necessary precision of path, just as a dense thicket of trees would obstruct a snowball fight. There is a delicate technique to be mastered before use

This question of vacuum hears pointedly on a question we have several times heard suggested. "Why not make an electron telescope working on analogous principles." To accommodate the plast this it would be necessary to create and maintain a vacuum—a sort of "tunnel full of vacuum—eler downthrough the earth's atmosphere to the instrument, and this would be such a tall order that the electron telescope will new —4.60.

THE CHEMICAL GIANT

THE present European conflict which threatens to engulf the world has been defined as a war of metal, petroleum, and high explosives But war also demands one other product about which the average person knows very little. He is still less familiar with the part which it plays in manufactur ing those weapons so essential in con ducting modern warfare Yet, without this product, we would be unable to turn out the huge tonnages of fabricated steel, prevented from producing the millions of barrels of refined oil and gasoline, and powerless to manufacture the immense quantities of high explo sives demanded by war

This product is sulfuric acid, a colorless, odorless, heavy liquid, the most useful of all manufactured chemicals and also the cheapest. It is produced in

Table I Sulfuric Acid Consumption in the United States by Industries, 1938

	Short Tons
Fertilizer	2,100,000
Petroleum	1,120,000
Iron, Steel, & Metals	850,000
Chemical	790,000
Coal Products	585,000
Paints and Pigments	430,000
Rayon and Film	310,000
Explosives	185,000
Textile	90,000
Miscellaneous	300,000
TOTAL	6,760,000

such enormous quantities that, even under normal conditions, the annual output is measured in millions of tons and, under war conditions, its production must be stepped up sharply to meet the increased demand

The only sulfuric acid which most of us have seen is that contained in the battery of our automobile. We know this acid vaguely as a highly corresive chemical which forms bluish green in crustations on the main cables leading from this storage battery, and that it will burn our hands and cat holes in our clothes if we happen to get splashed "Oil of vitriol," as concentrated sulfuric acid is commonly called, conjures up visions of a destructive product-and it is just that. The main reason why we are so unfamiliar with this acid is that it seldoms appears in the final product which it is instrumental in manufactur

As is the case with almost every essen-

Corrosive Sulfuric Acid . . . Indispensable in Peace and War . . . Used in Most Industries . . . Annual Production Runs into Millions of Tons

By WILLIAM H. WAGGAMAN

tial product entering into our complicated system of evilization, the United States leads the world in production of suffuric acid. Within a period of 27 years—1889 to 1916—our annual output of this chemical increased or 700 percent. According to the latest figures of the U.S. Bureau of Mines, we produced, in 1938, 6.760,000 Abort tons, having a value of approximately \$67, 600,000. This acid was distributed to the various industries as shown in Table. I

The most recent figures available showing how the various nations compare in respect to their output of this acid are those of 1937, when their proportion of the world's total production was as itemized in Table 2.

W/AR and preparation for war are reflected in the figures for Japan and Germany, since these two nations stepped up their production enormously during the past few years. Yet, in spite of the fact that we were at peace with all countries, the United States produced nearly one third of the world's total sulfuric acid in 1937, and twice as much as our nearest competitor. Japan. which was operating its plants at capacity in a feverish effort to end the 'little Chinese Incident" Should we be drawn into war our normal output of this chemical could be quickly increased by 50 percent.

Sulfuric acid is a compound of sulfur, oxygen, and water. Since water and the oxygen in the air are free, the chief raw material which must be purchased is sulfur or a sulfide ore (pyrites) containing sufficient sulfur to support combustion.

While sulfur is now obtained as a by-product in a number of industrial processes, most of the European countries are still dependent on outside outrees for a considerable portion of their requirements. Yet it is an intereuting fact that a few of the nations ordinarily classed among the "Hawe Nots," are well supplied with either sulfur or pyrites. Spain, Portugal, Creece, and Norway have large reserves. of pyrites, and 40 years ago Italy was the world's chief source of elemental sulfur

Since France is close to the inexhaustable supplies of Spanish pyrites, and Great Britain controls the seas, the Allies are assured adequate supplies of sulfur, and can probably present Germany from obtaming sulfur through herman ports On the other hand, as long as the Rome-Berlin Axis endures, and Stain remains Hitler's french, Germany may be able to obtain sufficient sulfur from Italy and Russa to meet her needs, provided, of course, she has the cash to nurchase it.

purchase it.

The United States, however, not only possesses immense reserves of pyrites, but the sulfur deposits of Louisiana and Texas are the greatest yet discovered, and the annual output from these fields eclipses that of all other nations combined.

the salfur hurns, it combines with the oxygen of the air to form sulfur droude, a stifting choking gas, the odor droude, a stifting choking gas, the odor the salfur droude as the overall stifting the salfur droude is capable of combining with a further quantity of converse the salfur droude is capable of combining with a further quantity of oxygen, but it requires a hitle "irging."

Therefore a third party, known in cleam sixty as a "catalyse." is employed to introduce this additional atom of oxygen must be compound. The product thus formed is known as sulfur trioxide which, in turn, readily combines with

TABLE II Production of Sulfuric Acid, 1937

Table compiled from figures of the U S Department of Commerce, and the "Chemical Trade Journal") France 6.86 % 12 78 " Germany 6.56 " Italy 15.60 " Japan *7.53 " Russia United Kingdom 6.86 " United States 31 00 12.81 " All other countries

water to form the useful sulfuric acid Most of the sulfuric acid is manufactured in immense lead chambers, but the pure concentrated product is made in more compact plants. While most of the sulfuric acid plants have been built for the prime purpose of manufacturing this chemical, others have been erected to recover this acid as a by product And this brings us to a strange story of how our annual output of

acid was unwillingly in creased by 1,000,000 tons

Many metal bearing ores contain rather high percentages of sulfur, and m roasting or smelting such material to recover the metal values, immense volumes of sulfur dioxide were released into the atmosphere Now sulfur dioxide is a rather heavy gas and quite toxic to vegetation It gradually settled down on farms and ranches, even though they were miles away from the smelters, and caused grave damage to crops The blame was traced to the smelters, and injunctions were secured whereby their owners were given the choice of either

collecting the noxious sulfur dioxide or closing down the plants. They chose the first course and, although it involved heavy expenditures, they erected im mense plants and turned the waste gases into sulfuric acid. Instead of proving an added expense or hability, the acid collected more than paid for itself, so that in some instances it is hard to say which should now be considered the main product-metal or sulfurn acid

Under normal conditions, the produc tion of this acid is a better index to a nation's prosperity than its output of steel and agricultural commodities, for sulfuric acid not only contributes liber ally towards the production of these basic materials, but it plays an almost indispensable part in the manufacture of the innumerable things which are in such demand when times are good. As an example, the year 1928 probably represented the peak of post-war pros perity, and we produced in that year 7,225,000 tons of sulfuric acid. But, in 1932 when we were in the depths of the greatest financial depression of all time. our output of this acid dropped to 4,401,000 tons, a decrease of about 40 percent

The fertilizer industry is the greatest consumer of sulfuric acid, and the larger fertilizer plants usually have an acid factory as part of their equipment In 1938, this industry required over 2,000,000 tons of sulfuric acid and it was by no means being operated at capacity, or tonnage would be greater

The next largest consumer of sulfuric acid is the petroleum industry. This acid is practically indispensible in the refining of oil, kerosine, and gasoline, vet here again, no trace of free acid is allowed in the finished products as it would soon ruin the delicate mechanism of the carbureter and score the cylinders of our automobiles In 1938, 1,120,000 tons of sulfuric acid were consumed by



Fertilizer is made in this plant, of which only a part is shown, by treating phosphate rock with strong sulfuric acid

different parts of the petroleum industry

The next greatest demand for sulfurio acid comes from the nutillurgual industries. Our huge output of metal products would be impossible without its aid. Mining operations could not be carried on as extensively or cheaply without the help of the high explosives which sulfuric acid is instrumental in producing, and after the various metals are separated from their ores, sulfurn acid is employed in ridding the surfaces of scale before these metals can be fab ricated into such finished products as wire, bars, sheets, pine, and tubing. This acid plays an important rôle in the manufacture of electrolytic copper, gal vanized iron, and nearly all types of metal industries of the 850,000 tons of sulfuric acid consumed in 1938, business would have been at least partially paralyzed

Until comparatively recent times, sulfuric acid was instrumental in producing many of the other important acids used in the arts and industries Although we have discovered other means of producing these acids, the demand for sulfuric acid shows no ten dency to decrease, for new uses are constantly developing elsewhere. It is the main power behind the chemical industry. The consumption of this acid for chemical and medicinal purposes in 1938 amounted to 790,000 tons

Without sulfuric acid, the movie industry would be prostrated until devel opment of some substitute to take its place in the production of the millions of miles of photographic films required The manufacture of one type of rayon would cease, and the candid camera would be relegated to the attic. In 1938. 310,000 tons of sulfuric acid were em ployed in the manufacture of rayon and cellulose films

In the home, sulfuric acid has been

instrumental in producing the heating plant, and the steel work, the steam or hot water pipes, so necessary in this system Sparkling clearness of faucet water is probably due to a compound of sulfuric acid. (alum), which is intro duced at the filtration plant to precipitate or throw out suspended impurities. This same acid has had a hand in the manufacture of keen edged razor blades, and is responsible in part for the chromium plated fixtures of the bath room

Soap, made by the socalled "English process, and shoe polish, whether ably been manufactured by the aid of this chemical

Without sulfuric acid there would be no family car Practically every part of the modern automobile, (with the exception of the glass), has been manufactured by the aid of this chemical The steel of the body, as well as the numerous metal parts, must be "pickled" in sulfuric acid before the finish is an plied. The nitro cellulose lacquer is produced through its agency, and the chromium plating also involves its use. Even the upholstery, whether it be of wool or artificial leather, has been produced by the aid of sulfuric acid or its derivatives

We owe our thanks to sulfuric acid for the enamel ware in the kitchen, certain ornaments in the living room, many of our paints and pigments, and for numerous dyes which impart beauty to the textiles used throughout the home The cans on the pantry shelf have been manufactured by the aid of the acid

Devoutly do we hope that American made sulfuric acid need only serve our peace time wants, but this nation's watchword is "Preparedness" therefore, our resources for producing this acid are being mobilized to meet any emergency. The output of sulfur has already been increased, new deposits of pyrites are being exploited, new trade routes established, and new acid plants erected This "Chemical Giant" of our constructive industries must be groomed to defend and preserve these industries should war be thrust upon na

INDUSTRIAL

COMPETITION FOR SWEDISH STEEL

TROUBLE in Scandinavia his upset other industries than those using wood pulp—paper and rawon producers. Cutting off of Swedish steel from world markets has given the razor blade industry a rude shock Practically all so-called wafer blades are made of Swedish steel regardless of brand

Steel imports for blades run several thousand tons an nually, and which this is a small term as steel tonnages run the product is a prenium one. Now, for the first time in history, American steel produces have a chance to capture this market, if they can do it. One concern has been work mig several years to develop a suitable competitor for the Swedish product and is now in production. Another slowly gets underway.

While almost anything can happen in the European situation, day-to-day news promises no prompt resumption of imports Couple this with the lack of any substantial invention in the hands of manufacturers and it spells an eventful pendence upon domestic mills—with quality in the balance

England and Germany have been large producers and exporters of blades to world markets. Lick the steel problem and much of this business should gravitate to American manufacturers.

PREFABRICATION BOOSTS PLYWOOD

WHEN the prefabricated house turns the corner, it will be found that plywood, not steel is the favored structural material Plywood has high strength, light weight, in sulating properties, and handles with ease. These qualitiespell thin walls and partitions, with savings in weight and cost, and ease in shipment Steel, while providing high strength, has been abandoned by most prefabricators because of weight, lack of insulating properties, and the need for paint protection to prevent corrosion

Chiefly responsible for the greater interest in physical the advent of the phenol formaldehyde resin binder, which holds the laminations of wood together, and makes the product suitable for exterior use. The resin bond is indestructible and is snathenia to fung and termitee Panels so bonded and kept under water for two years show no sign of separation even when the wood itself becomes waterlogged.

The prefabricated house is still coy about making a stage appearance, but the possibilities are much better today than they were four years ago when there was so much chatter about it. Out in front is a concern which offers all-factory made houses in nime standard sizes, but so skilfully designed as to afford a much wider style variety. About 500 were sold and erected last vear, this year, with a lower priced model, production may be doubled. Merchandising covers more than a dozen states and the company operates at a profit. This sums up to being a business and not an experiment. It shows what

Trailing this concern are several smaller ones, but none which meets so completely all the definitions of prefabrica-

tion. Some employ partial factory fabrication, others limit their operations to local developments. Most advocates of steel have shifted over to production and sale of framing and panels for industrial rather than housing use

Perfabrication has had many obstales to overcome and there are several hardles yet to take Early design was unattractive, costs offered very little, it any, advantage over orthodox construction, and strong resistance was met from every element in the building trades from labor on up through supply firms and contractors, to engineers, architects, finanties and public agents, short of the Government Design is now pleasing, costs favor factory work, but there is still sabotage. This is unlikely to be banished until the force of public demands sweeps it out of existence.

Approach to the problem has also delayed maturation of portains atom Most experimenters have been persons seeking new outlets for old materials. Thus, steel producers struggled to get steel houses on the market, while plumbing and electrical supply concerns hastened to find a box suitable to encompass their products. Only be consideration of housing and prefabrication needs first and then selecting materials to distribute the polyhastic harment of the concerns the polyhastic harment of the consideration of housing and prefabrication needs first and then selecting materials to distribute the polyhastic harmer to success been broken.

Proof of this is found in the experience of companies. The top flight predibinator, for example, spen eight years discarding preconceptions. Having tred metals, plywood was adopted, and it is not applied in typical building manners but skin stressed a la ariplane. That is, plywood panels are bonded to the frame with resins to make their bod carrying in mithers. Likewise, standard heating equipment was found unsuited and new types develored.

Manufacturers who are actually in production declare that prefabrication has outgrown the "nut and holt" stage of development, that further proccupation with technical matters will not accelerate the low-priced housing movement While much remains to be done, basic problems of construction, they say, have been solved with enough practicability to warrant placing major emphasis upon business building with more attention to consumer taster, merchandising and wide promotion.

This attitude is reflected in the statement of one producer who says. "The automobile is our chief competitor. When we can offer the consumer as attractive a piece of merchandwe with equally definite figures of first cost and upkeep, then we'll begin to have a business. The country isn't breathlessly awaiting the prefabricated house. It must be sold."

If prefabrication continues gams of the past two years what will it mean in material sales? A great expansion in the use of physical properties of the properties of the properties of more compact and economical plumbing, heating, air conditioning, and electrical fixtures, in which activity wide awake, small companies can play an important role It will mean also an expanding market for all household effects which go to make up a livable home.

When mass production means thousands instead of hundreds of new homes, it will pay to try to find something superior to plywood for walls. A really low cost plastic is wanted for panels, or, perhaps, something fashioned from farm products or wastes via the chemurgic road.

- Philip H. Smith

Insect Quarantine

Pacific Plane Service Provides Passage for Insect Pests . . . Hawaiian Farms Threatened . . . Midway and Canton Islands Have Pest Control Stations

THE United States may have to face an invasion which all the big guns of our Army and Navy cannot repel The foe is an army of insects. While transpacific plane service brought this country into rapid communication with the Orient, it also brought a threat of devastation. Plane service, smashing the barriers of time for man, has been quite impartial about man's enemy, the insect In the old days, the slower journeys

by steamer and sailing vessel were tough on insects with the urge to truvel for the usual insect's life cycle is so brief that few could last out long ocean voy ages on ships

Occasionally, however, insects did manage to survive trips, and the farmers of Hawaii saw and suffered from the destruction caused by the nests. Planters of sugar cane, Hawan's most important crop, early came to know the need for insect quarantine. They organused and created an experiment station staffed by agriculturists expert in bat tling the diseases of sugar cane and in sect pests

Through the knowledge of these entomologists, Hawan's sugar industry learned how to cope with insect enemies, to liberate in infested fields natural parasites to prey upon the pests, to re-establish nature's balance, and to defeat the invading hordes. But it learned also how difficult it was to bring insect allies from far countries to the Islands - - for the time interval for the voyage was as much a bar to parasites as to pests

WHEN Pan American Airways laid out its route for Clippers to and from the Orient, the scientists of the Hawanan Sugar Planters' Association urged that quarantine measures be adopted. With the permission and cooperation of PAA officials, a quarantine station was set up on Midway Island An entomologist was sent to inspect, search, and spray all planes arriving at that island Experience has proved that the defense was sound

In the course of a recent 10-month period, 66 planes were searched at Midway. More than 1200 insects were found to have died before arrival But the search yielded nearly 1100 live ones which were promptly placed in the scientists' puson bottle. It seemed that danger from the Orient was definitely halted

But the threat has reappeared in an other quarter Pan American has sur veved a route from Auckland, New Zea land, to San Francisco, via New Cale donia Canton Island, and Honolulu The first regularly scheduled flight will tol low approval of the route by the Acro nautical Commission at Washington and is expected to take off this year. Forewarned by experience on the Orient run. Pan American Airways, together with the Hawanan Sugar Planters' Association, have already taken steps to set up a second quarantine station on Canton Island for the new route

The reason for selecting Canton, an uninhabited atoll nine miles long and half as wide, is not apparent at first glance, but it is a sound choice. Canton is the intermediate landing point for Chippers flying between New Caledonia. a potential plague spot of the South Pa cific, and Honolulu, with its 154,476 population Capton, however has no human population, little vegetation, and few insects. Hence, it becomes an ideal spot for a protective quarantine control By the time the Pan American Clippers are ready to begin their flights, the HSPA bug man, already appointed, will he on hand with his sprays, and any insect stowaways heading for Honolulu will be summarily executed at Canton



The same speed which enables insect pests to survive long trips in planes, permits importation of insect parasites (in special cages, as shown above) to fight them

Sandia Man

Artifacts Found in Basal Layers of a Cave in ■THE archeological bird, which al New Mexico Give Evidence of Earliest Known Man ways flies backward because it doesn't care where it is going but in America . . . But Just Who Was That Man?

By FRANK C. HIBBEN

wants to see where it has been, is again on the wing A recent discovery in a New Mexico cave has pushed back the history of the first Americans still further into a shadowy past

Both North and South America have long been forced to take seats in the background whenever the question of the antiquity of man has arisen. Our predecessors of Europe who killed the mastodon and grappled with the cave bear are well known, and every grammar school child is familiar with their appearance and their tools. The New World, however, has not been able to boast of 50,000- or 100,000-year-old an

cestors with hairy skins and protruding jaws Instead, we on this side of the Atlantic have to be content with a moderate background of antiquity and with human beginnings derived second hand from the Old World by means of migrations across the Bering Straits It is for this reason that the

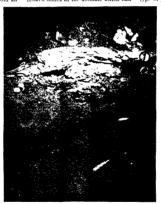
discovery of a cave habitat of ancient hunters in New Mexico has been followed with much interest by anthropologists These early Americans give promise of being the earliest inhabitants vet discovered in North or South America and comparable in age with some of the European oldsters

In the Sandia Mountains, near Albuquerque, New Mexico, three years ago some archeologists were crawling through a limestone cave of unusual length In the dust and debris of the cave floor one of them scuffed up a bit of hone - a piece long and curved and sharp on one end This was the claw of a giant sloth which had ambled over these limestone hills some 10.-000 to 20,000 years ago Since

this initial discovery, the Sandia Cave has been the scene of much activity Flickering torches and acetylene lanterns have sent shadows dancing in gloomy corridors where the sloth laired in by-gone ages. The chambers and passages of the cave have reverberated with the clang of the sledge and pick and the rattle of wheel barrows

Gradually there has come to light a human story which could be pieced to-

gether from evidence gathered during the last three years in this cavern home. Here there was a fire hearth with the blackened fragments of a camel jaw beside it, though many thousands of years have elapsed since the camel, which originally evolved in the New World, was native to the Southwest Dart points were scattered among the broken hones of the animals which had



A vertical section of the deposits in the Sandia Cave. Numbered layers indicate 1, the crust that sealed in the deposits below. 2, Folsom breccia. 3, yellow othre 4, the Sandia layer (note point found in place)

been killed, perhaps, with these same points Scrapers and knives of flint and bone splinters broken for the marrow gave evidence of Sandia hunters and their domestic life. A cave man of ancient America gradually took form.

This, in itself, is not remarkable, for evidences of a very early type of American who had hunted now extinct mammals and who lived during the rainy period just after the last glaciation have been found before Of these, one of the most famous is the so-called Folsom Man, named from the little town of Folsom. New Mexico Folsom Man was a hunter who ranged up and down the foothills of the Rocky Mountains hunting a peculiar type of bison or buffalo now long extinct. This type of man left traces of his passing in a distinctive type of tayelin point which looks like a

short bayonet with a groove Folsom points have been found from Saskatchewan to Texas and for the last decade have been considered as indicating the earliest known human evidence in the New World

A T first it was thought that the Sandia evidence was only another phase of the Folsom a variation perhaps, or another tribe Results of the latest digging has, however, given conclusive evidence of a group of man who hunted the green hills of New Mexico long before even Folsom Man These were contemporaries of the mammoth and the mastedon, and of the American horse and the camel and the savage predators who preyed upon them Evidence of these earlier animals is not founded on guesswork or even on clues, but is based on the science of Stratigraphic stratigraphy evidence is derived from the long-known fact that he who is first gets in on the ground floor. Thus, if we dug in New York, we would find the relics

of the Gay Nineties buried in the city dump below the more modern remains of our own era We would correctly conclude that the battered remains of the horse car represented an earlier vehicle than the automobile which lay above it. The loker in the stratigraphy is, of course, in the difficulty of finding remains which overlie one another. If, instead, the deposits are side by side, no matter how primitive or advanced one

or the other might be, it is difficult to establish the precedence of one over the other conclusively.

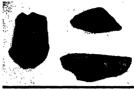
The Sandia Cave, happuly, is well stratified. On the top surface throughout the cave is a heavy deposit of dust, but guano, and broken fragments fallen from the roof. Mingled with this dust at the front of the cave are fragments of pottery, baskets, and yucca sandals of the Pueblo era Below the uppermost layer of dust is a crust of stalagmitic material some three to axi methes thick (marked J in the photograph)

This records a period when the cave was wet and when water containing calcium carbonate in solution dripped from the ceiling and spread out over the cave floor in a sheet which was deposited as the water evaporated Under ordinary conditions only a fraction of an inch of this material is formed in a century More important than its possibilities of indicating age in the cave, it was effective in sealing in the deposits below it, and thus prevented any mixture of recent material with the ancient which hes beneath Thus the remains of extinct mammals and the cultures which ac-

mais and the cultures which accompany them have been completely enclosed and unaffected by disturbing in fluences until the sledge and the pick of the archeologists broke through.

THE geological epoch just prior to our own is called the Pleistocene. This time was characterized by the formation of great sheets of ice in Continental glacier form in both North America and Europe The fauna of the Pleistocene is extremely distinctive, insomuch as most of the species then extant are now extinct Wet periods accompanying these glacial times made great changes in areas now dry. The mammoth grazed amidst plenty on slopes which are now barren and rocky The stalagmitic crust in the Sandia Cave is evidence of one of these wet periods when the hill above the cave was deluged with rains and snows now unknown there All material below this crust is Pleistocene in date No mammal bone or fragment of Pueblo culture occurs below this level

Immediately beneath the calcium carbonate capping of the cave he a thick layer — the one marked 2 — of debra, dirt, and bone fragments consolidated into a homogeneous mass by the same material as the capping above. This consolidated material is a great flat hasty pudding in which are mixed ingredients which were lying around on the cave floor in the late Pleistoceae. There are fragments of home and teeth representing the garbage piles of beast and men. Pieces of rock of all sizes are covered with dust blown or carried in from the cave entrance. Chips of flint, scrapers, and points are consolidated in this material as though liquid cement had been poured over the whole to make sure none moved from the positions they had assumed during the Plestocene. Most interesting is the fact that the projectile points in this material are true Folsom type. Eudenly the Folsom lisson hunters occasionally used the case when on trips in the vi-







Above Stone strapers and gravers of Sandia man, also javelin points At left. A Folsom point, the darker object, not the brighter one, found embedded in a matrix near a bove of a camel proving their contemporaneity.

cinity, and lost or left them there

Beneath the Folsom Jayer Ines a thick deposit (marked 3) of yellow other stratified in lammae and evidently water laid. This, then, represents a second or earlier wet period in the cave's history. At this time the drip and trickle of the cave waters were not disturbed by any inhabitants or visitors. The sloth shunned the mud and sline of the cave floor, and so did man as well, for there is no indication in the other layer of any disturbance or any casually dropped underneation to home.

Below the ochre and between it and the solid limestone of the cave floor are the most important deposits of the cav ern (marked 4) These were accumulated during a dry period, the first in the varied history of this abode. In these lowest levels there was again evidence of grisly meals, bone fragments, fires, and flint implements. These latter are javelin points entirely different from the later Folsom variety They are notched from one side, forming a single shoulder in a manner very similar to flint points of the Paleolithic or Old Stone Age of Europe That the Sandia points may be comparable with some of the earliest implements of Europe is a distinct possibility.

European remains of the Paleolithic variety were made mainly by types of men having certain primitive characteristics. They walked with a stoop-shouldered, bent-kneed gait Their heads were fastened on their necks far forward, like those of a gorilla, and their jowls protruded while their forcheads receded Such a type of man as these has been eagerly sought for in the New World since scientific endeavor in Europe began So far, there has been no success. First, Folsom Man and now Sandia Man, seemed to give promise of being this American link. The probable truth is that even such an oldster of the last of the ice age as Sandia Man would look no worse if we saw him on the street than some of the least attractive of our politicians Yet, in order to satisfy a perfectly natural as well as scientific curiosity, we would like a look at Sandia Man's bones - if only he has left one of his dead in a corner of the cave, and if the rats have spared him sufficiently so that we can see his outline. Such a discovery would solve one of the most pressing of the queries concerning the mystery of the first Americans Sandia Man lived, loved, hunted, and died in the time of the mammoth and the sloth we now know Perhaps the as yet unexcavated portions of the cave will answer the questions of his appear-

M Readers will note that, in the case pust described, the evidence calling for Pleistocene antiquity is based on stratigraphic grounds. In all too many of the instances where claims of high antiquity were made these were based on tiquity were made these were based on finding human artifacts associated with bones of animals that lived in Pleistocene times — and nobody yet knows how much longer toward or even into our own rea—The Editor

Is Atomic Energy Nearer?

Physicists Talk Down Some Fabulous Claims... But New Findings May Alter the Picture... Prediction Probably Unsafe.. Immediate Development Unlikely

By ROY H. COPPERUD

E YES of the scientific world — and for a good part of the lay population, too — widened the first week in May at the startling news that work of a 28-year-old physicist at the University of Minnesota in isolating the explosive unanium rootope. U235 had been corroborated, marking a significant advance toward-shackling atomic energy.

The physicist is Dr Alfred O.C. Nier who modestly expressed dismay at extravagant reports which blossomed on front pages everywhere, to the effect that the incalculable forces of the atom were on the verge of being pressed into the service of mankind.

There were fabulous predictions that this discovery made feasible hombs of unheard of strength, that her or ten pounds of U 235 would propel a vessel around the world for an indefinite time without refueling — in short, that economic foundations of the world were about to eximple.

The fact of the matter he insists, is that many a knotty problem remains to be solved before any useful harnessing can take place. Chief among these is extraction of U-235 in vasily greater quantities than is possible now.

Yet authorities in the field concede that the discovery is a stride of unprecedented importance toward opening up a new and virtually limitless source of power Dr. Nier himself admits that large-scale extraction 'is surely within the range of possibility."

It was the work of Dr. John R. Duning at Golumbia Universite in New York, added by Dr. E. T. Booth and Dr. Aristid V. Grosse, that clinch at the findings of Dr. Nier. The New York physicists. Subjecting Dr. Nier's in finitesimal samples of U.235 to a slow neutron hombardment, confirmed sixcessful isolation of the isotopic, and demonstrated its explosive properties.

For about a verr previous to last February, when Dr. Nier first accomplished the separation, it was known that uranium would blow up if hom harded with slow neutrons, releasing immense energy. Discovery of his fact was made by two Germans, Dr. Otto. Hahn and Dr. Las Meutner, in Berlin. The explosions, however, were incomplete and the results baffling Baffling, that is, until a theory was advanced to Prof Niels Bohr. Nobel prize winner at the University of Copenhagen, and Dr. John A. Wheeler of Princeton University, that U255, one of the three isotopes which constitute uranium, was responsible.

This was only a hypothesis, albeit a good one, until Dr. Nier blazed the trad in separating IU-235 from its brother isotopes, IU-234 and IU-238. Sieving them out in a mass spectrometer, he obtained quantities sufficient for testing. These were sent on platinum collecting plates to Columbia.

W HAT happens in the hombardment is that slow neutrons crack U-235 atoms as a baseful last would crack a walnut, splitting them in two Accompanying the explosions as terrific release of energy. Particularly significant is the fact that, in a quantity of U-235, the process is cumulative, for the smash series free other neutrons, which in turn attack other atoms. Once begin, the process will continue automatically—a "chain reaction"

when natural uranum was first hombarded, the explosions did not continue in this fashion because of the great preponderance of U-238 The stray neutrons which would keep the action going in pure U-235 collided with atoms of U-238, which are unaffected by the slow barrage that shatters U-255 Consequently, there was an effect of snothering Even with pure U-253, a considerable amount would be required, for many of the neutrons five fibramlessly unto the air

Dr Nier estimates that one pound of U-235 would generate as much force as the combustion of 2,000,000 pounds of coal, or that its detonating energy would be equivalent to that of 20,000,000 pounds of high explosives

All of which sounds vastly encouraging [and just at present in some aspects a bit alarming—Ed]—except that the greatest amount of the isotope that he has yet been able to produce is less than a microscopic 1/100,000,000 of an ounce

and the second s

Dr. Nier's separation work was duplicated by Dr. K. H. Kingdon and Dr. H. C. Pollock of the General Electric Company's laboratories, and their samples produced the same result in the Columbia evolution as those isolated at the University of Minnesota.

Rumors said that the discovery had set all available researchers in Germat at work in the Kuser Wilholm Institute at Berlin to seek a means of conomiculive extensing 19-255 in commercially usable amounts 1 arge deposits of uranium are found in Germany, also in Canada the Belgian Congo, England, and Colorado

Dr. Nier estimates that even with any reasonably economical means of extracting U-235 in large quantities the cost per unit of energy produced would equal that of coal "%a vou see," he observed, "it would not mean getting power for nothing." Despite the extraction cost, the great amount of energy concentrated in a small volume would make it invaluable for airplanes, for example, or any other apparatus where weight of fuel is a consideration.

The Minnesota scientist considers it hardls likely that the mass spectrometer, the device he used to separate the training inserting the adapted to mass production. It is more probable that some chemical means of separate not would turn the trick. But as to any such method, researchers are still at asea. Dr. Nier emphasized further that, once extraction is accomplished, the problems of handling and chaning the atomic force safely might occupy scientists for years.

This is the abbreviated story of what may well prove to be one of the great crests of scientific achievement. True, researchers are cautious about advancing ambitious claims, and Dr. Nier himself believes that remaining obstacles to chaming atomic power will persist for including atomic power will persist far into the missy future But only ten vears ago it was considered impossible to separate the isotopes of any element whatever, and now it is being done commercially with hydrogen.



SYPHILLS IN U.S. The annual attack rate of syphilis per 100,000 people in the United States in 1935 was 796, compared with 47 in Great Britain (clinics only), 20 in Demmark, and seven in Sweden —The Journal of the American Medical Association, 114, 1321 (April 6, 1940).

ELIS-MA MEDIANIS. The mathematical theories of the releval motions are of a complexity atmost beyond conception, and the length of some of the calculation involved is appalling single formula that fill dozen of printed quarter pages, series expansions in which hundreds of terms must be used, and single calculations that require years to accomplish, are not unusual in celestial mechanics. Edgar W. Woolard, National Mathematics Margine, (January 1980).

DON'T BLAME THE RAZOR—The average man, "cussin!" his razor blade roundly, doesn't realize that each hair's breadth of blade edge has to cut 100 hairs in a once over shave or 200, twice-over - E. J. Casselman, Mellon Institute of Industrial Research

OIL PAYS - Nearly one twelfth of all the carload freight revenue of American radroads in 1939 was paid for the transportation of petroleum products. Interstate Commerce Commission

AUTOMOTIVE COSTS - The typical wage earning, car owning family spends \$197.74 annually to operate its ear for business and pleasure. U.S. Burcau of Labor Statistics.

INSULATION SAVIS United States Government tests on identical houses, one insulated and one not insulated, showed a fuel cost for the insulated house 44.75 percent lower than that for the non-insulated. National Warm Air Heating and Air Conditioning Association, II West 12nd Street, New York

WAR AND PAPER—American paper makers regularly import from Scandinavian countries more than one fifth of the pulp they need, with Sweden leading among suppliers—Science Service, (April 11, 1940)

LONG RAYS WEAK.—Suggestions that long, invisible infra red radiation could be used to pierce fog have been refuted by experiments—J. A. Sanderson, U. S. Naval Research Laboratory, Washington, D. C.

INSECT ENEMIES —Throughout the world, there exist nearly 500 plants that are carnivores, or insect eaters - Brooklyn Botanical Garden, Brooklyn, New York.

"HYPODERMIC."—Oil squirted at high pressure from tiny holes, such as those in Diesel injectors, often penetrates the flesh of workers. Though the oil penetrates to a considerable depth, the worker is not immediately aware of his injury.—Dr. G. Failla, Memoral Houpital, New York. BETTER SHOOTING. During the recent war between trainand and Russan, the average number of shots thread for each arrange destroyed was 54, contrasted to 11,000 shells needed to bring down toth arrplane at the beginning of the World War and 6000 shells at the end of that War. The Illustrated Loudon News, (April 13,

SPARKLESS - To prevent generation of static sparks by belting, one powder manufacturing company keeps belts in a most condition by frequent applications of 50 percent glycerol and 50 per cent water. News Edition, American Chemical Society, 18, 355 (April 25, 1940).

PFTROLEIM RESEAR II. The growth of research in the patroleum industry has been most rapid than in most undustries having expanded 639 percent in II. years and having risen from seventh largest to second largest. For every 10,000 wage carriers in the patroleum reliming industry there are 503 research workers, almost takes as man as in the chimical industry which is reported to have the next highest concentration. News Jeldinos, American Chemical Security, 18, 337, April 25, 1900.

PROVED SUPERIORITY - The aluminum nurror coating of the 199 inch telescope at the Mount Wilson Observatory lasted five via and was recently removed "silver costings, formerly used on the cope nurrors, lasted only a few months - Publications of the Autonomical Society of the Parities 52, 185, April 1990).

OH UNLIMITED. It seems altogether likely that nature is continually producing more oil underground, perhaps at a faster rate than gas pressure or pump stroke can bring it to the earth's surface. Dr. Gustav Egloff, Universal Oil Products Company, Chicago, Illinois.

(JHNAHILLA FUR - Eleven thindullas were brought from South America 17 verse ago. Though difficult to breed in the United States, the original group has grown to \$500, 2000 of which are located in the home chindulla ranch in California, while the renormer are scattered throughout the country - Trane Company, La Crosse, Wiscomin

FAT PROPLE. The old belief that women can withstand cold better than men has been proved correct by calorimetric measure ments made on nude men and women at the Cornell University Medical College. It was shown that, if men were by nature provided with a layer of fat tissue about one swith of an meh thick, they would be on a par with women in best retention—National Academy of Sciences, Abstracts, Annual Meeting, 1940

HEAT DEATHS—In 1939 more persons died from heat stroke indoors than out. The exact percentages were 671 percent in the home, 22 percent in factories, and 109 percent in public places. The reason is simple. Both the very young and the very old—most susceptible to heat—spend more of their time indoors than do others—National Warm Air Heating and Air Conditioning Association, 11 West 24nd Street, New York.

JULY - 1940

BLEAK BLACK BALL OF ROCK

A PROBLEM which looked as if it might remain unsolved for many years has been cleared up recently by Professor Brouwer of Yale—who reported his results at the last meeting of the Astronomical Society Ever since Pluto was discovered, attempts have been made to find its mass—and previously with no success

The problem is simple enough in principle, though very complicated and laborious in detail The attraction of Pluto upon the other planets modifies, or "perturbs" their orbits, by an amount proportional to the attracting force, and hence to the mass of Pluto itself-which can be found, if we can determine from observation the actual magnitude of these perturbations Given precise information about the orbits of Pluto and any other planet-say Neptune-the calculation of the perturbations can be made by standard methods-none of them simple, because the problem is inherently complicated mathematically There are two main lines of attack-the "general" method, which derives formulas from which the perturbations can be calculated at any time, and the "special" which determines their effects only for a given interval of time.

The first is enormously laborious, especially when, as in the present case, the orbits are eccentric, inclined, and come relatively near one another. When the results have been obtained, they are applicable almost indefinitely. Hence these methods alone are of value for the Moon, the satellites of Jupiter, and the maner planets, which have already been observed over hundreds or thousands of revolutions.

The second method calculates step by step, giving accurate values over the interval of time covered by the computations, but tells us nothing about the future until the calculations have been extended to cover it. For two or three revolutions, or less, this second process costs less work than the first.

The two methods follow entirely different mathematical paths—diverging at the start and meeting only at the finish so that, when both have been applied to the same case, they afford a very complete check upon one another

The perturbations of Neptune, for example (except those due to the undiscovered Pluto) were calculated by Newcomb 40 years ago. A recalculation by the second method has just been made by Brouwer, using modern "punched-card" calculating machines, which save a great deal of time and money. The

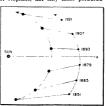
After Ten Years the Planet Pluto's Mass Has Been Determined . . . Denser, Darker, More Massive than Was Expected . . . Laborious Computations

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory
at Princeton University Research Associate of the Mount Wilson
Characteristry of the Carneric Institution of Washington

results of the two methods agree excellently, over 160 years, except for a regularly recurring deviation in longitude, of maximum amount 0" 15 with a period of 12 8 years, exactly that in which Jupiter catches up with Neptune A term of this period appears in Newcomb's tables, and it is clear that, despite the great care taken by this distinguished investigator and his assistants, some unmerical error must have crept into its coefficient. Recalculations are being made by the first method.

THE perturbations due to Pluto can be calculated, just as well as for any other planet, but when the attempt is made to use them to find Pluto's mass, a new complication arises

We must find, from the observations of Neptune, not only these perburba-



Positions of Neptune and Pluto, projected on plane of Neptune's orbit

tions, but the size and shape of its orbit. If Nepture had been observed all around its orbit for several revolutions, like Jupiter and Saturn, we could determine the orbit almost independently of the perturbations, since these would be different in successive revolutions, and almost average out. But Nepture was discovered in 1846, and has been only a little more than half-way round the Sun since then. Consequently, when its more in the second of the consequently, when its more in the second of the se

attraction, would simulate very closely the motion of Neptune in its real orbit. disturbed by Pluto The motions of the real and fictitious planets would diverge in the unobserved parts of the orbitbut this leaves us no wiser, though our grandchildren will be The existing or bits of Neptune, calculated, without taking account of Pluto, so as to fit the observations as closely as possible, are of this "fictitious" type, and it is only from the differences between the observed positions of the planet and those calculated from these adjusted orbits that we can find out how much influence Pluto really exerts

This matter was thoroughly discussed, a few years ago, by the late E W Brown He concluded that it was not at present possible to obtain a reliable determination of Pluto's mass, either from observations of Neptune, for the reasons aforesaid, or of Uranus, which is too far from Pluto

Brown, however, considered only the longitudes of the planets. The lattudes —measured, if we will, from the mean orbit plane—usually suffer much smaller perturbations—ance all the planets move in nearly the same plane. But pluto's orbit has the high inclination of 17 degrees to the ecliptic, or 15½ degrees to the orbit of 17 degrees to the cliptic, or 15½ and the puts of the country of the planets of the switch means of th

The situation is illustrated in the sketches. The first represents the positions of Neptune and Pluto during the interval of observation as projected on the plane of Neptune's orbit. The planets were in conjunction in 1892, at a distance of 19 setroomical units, and have been closer together than the average over the whole time

The second sketch represents the planets as seen from afar perpendicular to the plane of Neptune's orbit, along the line Sun-X in the first. From this point Neptune would appear to oscillate back and forth in a straight line passing through the Sun-X will Pluto, during the interval of observation, was continuously on the south side of the orbit plane.

The attraction of Pluto on Neptune throughout this interval tended to pull Neptune away from the Sun, as is evident from the first sketch, but, as has been explained, the principal influence of this will be to alter the calculated elements of Neptune's orbit. But the component of attraction at right angles to the plane of Neptune's orbit tends to pull it out of the plane. No adjustment of the assumed orbital elements can do much to help this, for, in the absence of perturbations, the orbit must be exactly plane. (The actions of the other planets can be accurately computed and allowed for-after which they may be ignored, and only Pluto considered)

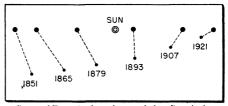
After making the best adjustment of the calculated plane that we can, we may expect to find Pluto south of this south as the beginning of the observations, north of it in the middle, and not south again at the end. This exactly what Dr. Brouwer has found, after making just such calculations. In 1850, Neptune was 0°5 south of the calculations in 1950, 0°4 south. Though there are some fluctuating errors in the observations—as is inevitable—the general trend is unquestionable.

M EASURABLE effects of the attraction of Pluto on Neptune have thus been found From these Brouwer finds that the mass of Pluto is 1/400,000 that of the Sun, or 83 percent of the Earth's, with a probable error of eight percent

The perturbations in longitude, between 1846 and 1936, are almost completely obscured by the adjustment of the orbit But two earlier observations of Neptune exist Lalande, in 1795, while cataloguing faint stars, made two observations of the planet supposing it to be a star. These agree well with one another, and give a residual deviation of 10" in longitude from the orbit adjusted without regard to Pluto If perturbations by Pluto, with the mass determined from the latitudes, are taken into account this discordance disappears By itself, this deserves no great weight, as Lalande's observations were not of high accuracy; but the agreement of the two determinations is satisfactory.

Dr Brouwer is investigating Uranus by similar methods. Here the attraction of the Sun is greater, and that of Pluto less, but it will be of much interest to learn what can be derived, especially from the latitudes, but it is improbable that the results will compare in accuracy with those already derived from Neptune.

The mass of Pluto thus takes its place in the list of known data for the solar system. It is surprisingly great—equal, within the limits of error, to that of Venus, which is 1/410,000 of the Sun's. It is not the actual value which is surprising—we have no excuse for any



Neptune and Pluto, projected on a plane perpendicular to Neptune's orbit

anticipations on the mere knowledge that a trans-Neptunian planet exists But the faintness of Pluto suggests a much smaller value

If Venus could be out at Pluto's average distance from the Sun and Earth at opposition, a simple calculation shows that it would appear as a star of visual magnitude 11 8 The measured value for Pluto, reduced to the same standard conditions, is 14.7 Hence Pluto reflects only seven percent as much light as Venus would if put in his place If of the same size as Venus, his reflecting power, or albedo, must be correspondingly small Now the albedo of Venus has the high value 0.59 but even so. that of Pluto comes out only 0.04 This is so very low that the planet's surface would be called dark gray, or almost black (not brown, for Baade's observa tions show that, unlike the Moon, the light which it reflects is of the same color as direct sunlight).

The Moon itself reflects seven percent of the incident light. If it were not for the weakening of the light of the half moon by the shadows of the innumer able roughnesses on its surface, this value (which represents the average for light reflected in all directions) would be raised to 10 or 12 percent. We see Pluto at the full phase hence it may be concluded that, if it is of the same size as Venus the average reflecting power of its surface is probably between 30 and 40 percent of the average for the

This is clearly not impossible, for the darkest spots on the Moon are made darker than the average, but it is about at the limit of plausibility

We cannot well escape the difficulty p assuming that Pluto is smaller than Venus, though of the same mass, for this would make it demeer, and Venus, with a mean density 4.9 times that of water, is denser than any other planet except the Earth.

TO assume that Pluto was twice as dense as Venus would be going wild —making its mean density greater than that of the core of the Earth, composed of metal under enormous pressure. But

even this would raise the calculated albedo only to 0.06

There seems to be no escape, therefore, from the conclusion that the surface of Pluto is almost black. This is the more remarkable because Pluto, like Venus or the Earth, ought to be able to retain an extensive atmosphere. It is reasonable to suppose that, like these planets. Pluto lost any hydrogen which its atmosphere contained early in its career But an atmosphere which contained water-vapor like the Earth's, or carbon dioxide like that of Venus, would, at the very low temperature of Pluto, send these substances down in permanent snow. Nitrogen and the mert gases would remain to form a permanent at mosphere, even at this temperature; but, if this atmosphere were of any considerable extent, it would scatter enough light on its own account-like the skyto make Pluto look much brighter and bluer than it is It appears, then, that Pluto is an atmosphereless ball of black

All this depends on Brouwer's determination of the mass, but the evidence for this is so strong that it altogether outweight considerations based upon the supposed improbability of conditions which certainly do not appear to be physically impossible.

Neptune's satellite, sometimes called Triton, is of very nearly the same brightness as Pluto-or, at least, it would be if the two bodies could be observed at the same distance, which will happen about 1989, when Pluto is in perihelion The satellite's mass has been determined by Nicholson, van Maanen and Willis by observing the small oscillation of Neptune's position about the center of gravity of the system as the satellite describes its orbit. They find a value about one twelfth of the Earth's mass, or one tenth of Pluto's Allowing for a slightly lower density, we may estimate that Triton has about half the diameter of Pluto, and four times its albedo. The difference between the two bodies is surprising, and illustrates the danger of guessing at the mass of a planet or satellite from its brightness - Princeton, May 4, 1940.

SEEING WITH ELECTRICITY

In this age of super-movies, supertelescopes, super-cyclotrons, and super-whatnots, we are apt to pass sover lightly the news that a super-microscope has just been built. But such news has just popped out of New Jersey, following within a year two similar announcements from Canada and Germany; and to anyone interested in the progress of science, it sounds a good deal more important than the Jatest super-movie

The electron microscope already has become a powerful and a practical in strument. With it, science can explore





ELECTRON MICROSCOPE
Figure 1 A comparison of the optical and electron microscopes. The
one does its ray bending with glass,
the other with magnetism from the
coils La, La, Explained in text

a new world of things infinitely small—disease viruses, for example, which have never before been seen or photographed—and this may lead to important medical discoveries

We are all of us familiar with the ordinary optical microscope Perhaps we have used it in the laboratory to see the teeming life in a drop of pond water. or to study the fragile nerve endings in the tissue of a frog's leg. The upper part of Figure 1 shows how such a microscope works The object or specimensuppose it is our drop of pond water-is represented by the short arrow AB. It is brightly illuminated, light from the lamp is concentrated on it by the lens L. The lens L. bends the light from the object and focuses it to produce an enlarged, inverted image of the water drop at A'B' Then the lens L takes light from any part (such as the section CD) of the first image—a single amoeba. perhaps, swimming sluggishly in the drop-and re-focuses it to give us a still more enlarged image at C'D' This is what we see if we peer through the evepiece of the microscope, or what we can New Electron Microscopes Now Being Developed Far Outdo High-Powered Optical Microscopes . . . Reveal a World Hitherto Unseen by Man

By JEAN HARRINGTON

photograph if we care to put a film there. The electron microscope shown in the lower part of the same figure is arranged and behaves quite sundard. It has ellumination, three lenses, and two magnified images in cascade. But, instead of light for illumination, it uses streams of electrons from the hot filament or cathode at F, and in place of glass-lenses, three magnetic coils, by curving the electron paths, do the focusing A more detailed discussion of the instrument will be found later in the article

The analogy between the two microscopes follows the close analogy between light and electricity. Visible light, we know, is a wave motion, one of a large family of electro-magnetic vibrations ranging from radio waves to the gamma rays from radioactive materials Figure 2 shows where visible light ranks in this family From the broadcast and shortwave radio bands, down through the infra-red or heat rays, from the red to the violet of our sunlight spectrum, down through the ultra-violet and the X-rays. the wavelength steadily decreases, when we come to gamma rays, we have waves less than a billionth of a centimeter long For convenience, these short wavelengths are measured in angstrom units, an angstrom being a hundred-millionth of a centimeter, or 1/250,000,000 of an inch The visible spectrum ranges approximately from 3900 to 7600 angstroms

WE usually think of an electric current as a stream of electrified particles rather than as a train of vibrations or waves. The electrons flowing in our telephone and lighting circuits we picture as tiny bundles of negative charge Yet the curious thing about them is that under certain circumstances they behave as if they were waves instead of particles In 1924, De Broglie showed that, in theory at least, a moving electron should have a definite wavelength associated with it, and his theory was proved true by experiment some three years later It was shown that electrons, like light, can be reflected or refracted at surfaces, and are subject to familiar interference and diffraction phenomena in which different electron streams add or subtract to form patterns of light and shade (Parentheteally, just as electrons act sometimes like waves, light waves on occasion behave like particles—a beautiful if somewhat confusing example of the harmony and inter-relationships of nature)

The De Broghe wavelength of a moving electron depends only upon its velocity, devreasing as the speed increases. A "one-volt" electron—that is, an electron accelerated by a potential difference of one volt—travels at nearly 370 mile-pre-second, and has a wavelength of about 12 angstroms A "million-volt electron," whizing along at more than 175,000 miles per second, has a wavelength of about a hundredth of an angstrom. How this range compares with that of light is shown in Faure 2.

that of tight is shown in Figure 2.

This comparison leads to the essential advantage of the electron microscope over the optical variety. The ability of any kind of microscope to show clearly minute objects is sharply limited by the wavelength of the illimination it uses. It has been found in practice that this limit is approximately half the value of that wavelength. In other words, you can't distinguish objects or details of objects the dimensions of which are less than half of the particular wavelength

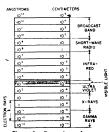


Figure 2: Comparison of wavelengths of the family of electromagnetic waves and of electron rays

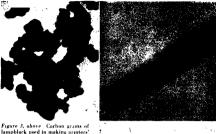
you choose for illumination Obviously, then, the shorter the wavelength, the smaller the details you can observe

The reason for this is to be found in the phenomenon of diffraction Without going into a full explanation, which be longs in a book on optics*, suffice it to say that diffraction is a special case of interference of waves, and is caused by wave trains bending around corners or the edges of opaque objects. Although the phenomenon is universal, we don't ordinarily notice it, for the effects are negligible when the object is large and the wavelength small. But in microscope work, where specimens and wavelengths are the same order of magnitude. diffraction rears an ugly head There its effect is one of diffusion and blurring A sharp line in the specimen appears in the image as a broad one, flanked on either side by bands of dark and light A point reproduces in the image as a disk surrounded by dark and light concentric circles. These are known as "diffraction patterns"

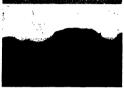
When you see a circular diffraction pattern in a microscope, you know a particle is present, but different sized particles may have identical patterns and you can deduce nothing about the actual magnitude and shape of the par ticles. Or if two particles in the specimen are less than a half wavelength apart, their diffraction patterns overlap in the image and you cannot distinguish them as two separate points. The size of the diffraction pattern does, however, decrease as the wavelength decreases. so it happens that, with short-wave illumination, there is less overlapping of patterns and therefore greater clarity in the image.

THE resolving power of any micropoints of a specimen can actually be separated and still appear as two distinct points in the image. We have already said that this shortest distance cannot be less than the half wavelength of illumination Thus, with visible light of 4000 angstroms, you cannot get a clear, detailed image of anything much smaller than 2000 angstroms or .00002 centimeters (1/125,000 inch) in diameter With ultra-violet light you may get down as far as 1000 angstroms But now, with high speed, short-wave electrons, it has become possible to observe objects and details of objects smaller than 100 angstroms in diameter - that is, about 1/2,500,000 of an inch

A good example of the electron morroscope's power is Figure 3, a photograph of the carbon grains in ordinary lampblack. The individual grains are completely invisible in the most high-powered light microscope or even in an ultraviolet microscope. At best, these microscopes show the patch of lampblack



lampblack used in making printers ink, magnified 100,000 diameters One of the best electron microscope photomicrographs ever made. Figure 4, upper right A diphther-oid bacillus. Figure 5, right Edge of a new razor blade, magnified 23-000 diameters. All three figures were made at the Iniversity of Toronto



only as an arregular, solid, black blob at ulmman solid, black blob the state wave electrons, and it resolves itself into the wave electrons, and it resolves itself into them as a myraid of particles, some of them as small at 8.30 angstrons in diameter and about 17-80,000,00 of an infert. This photograph was made with the new photograph was made with the new formation and the small photograph was made with the new formation and the small photograph. The total magnification is 100,000 ftms, and here a word about magnification is 100,000 and here a word about magnifications.

In order to be distinguishable on the photographic plate, the smallest details of the final image must be several times of the final arger than the chemical grains that make up the film. These are about 001 alorger centimeter in diameter. If the smallest detail of Figure 3 is 30 angstroms (0000003), em) it must therefore be magnified some 10,000 times (up to 003) on jf it is so appear on the film at all

But, in order to be visible to the an aided eve, objects must be at least as large as 02 cm—about 1/125 of an inch Therefore, the 003 cm detail of the microscope photograph must be enlarged up to 02 cm—a magnification of 67 times. This is done by enlarging the microscope picture by ordinary dark-room methods.

The total useful magnification is then 10,000 x 67, or 67,000, this represents the total enlargement necessary to make the smallest detail usuble to the unaded eve. Further magnification only makes are more convenient size for study. In some cases it is possible to study. In some cases it is possible to the whole useful magnification with the electron microscope, but for technical reasons it is easier to keep

its magnifying power under 20,000 and supplement it with optical enlargement

Figure 4 is a diphtheroid bacillus, also photographed by Hillier with the To ronto instrument. The bacillus, magnified 35 000 times is about to divide in reproduction, as shown by the slight constriction of its waistline. Such a photograph is again utterly beyond the scope of even the best optical micro scopes. An enormous number of other organic and inorganic minutiae bacteria, viruses, crystal structures, colloidal particles and the like-fall within a size range of from 1000 down to 10 angstroms, or 1/250,000 inch down to 1/25,-000,000 inch, and it is in this range that the electron microscope has already proved itself so valuable

IT may well be asked why X-rays or gamma rays, with wavelengths as small or smaller than elections, could not be used for the same purpose. The answer is that no one has ever been able to devise a lens that would focus them. Though they belong to the same family of electromagnetic vibrations as light, they are too short-wave to be refracted appreciably by glass, as is light, they are true that X-rays are very useful in examining the minute intracaces of crystal structure, but the method is entirely different from microscope technique by

The electron microscope is less than a decade old, for its development, which has recently reached practical fruition, began only a few years after the proof in 1927 that electrons have wave properties. The first steps were experiments showing that an electron beam can be

^{*} For example, Valasek's "Elements of Optics" - Ed

focused by a magnetic or electrostatic field, providing the field is symmetric around the axis of the beam. The curving of electron paths in such fields is analogous to the bending or refraction of light rays as they pass through glass, and the field enclosed by a charged hollow cylinder or a solenoidal magnetic coil is thus analogous to a glass lens

The first electron microscope having



Figure 6 The electron microscope at the RCA laboratories Electrons from top are converged by condenser coil, traverse specimen (introduced through an art lock) above objective coil. This coil magnifies image to 100 diameters Projection coil re-magnifies this image 250 diameters. The image 15 observed through two diagonal side-windows.

magnetic fields as lenses was begun in Germany in 1931 by Knoll and Ruska Not until 1934 was it perfected enough by Ruska to show a definite superiority over optical microscopes. Since that it warious physiciests have been toiling to remove still more of the kinks and turther improve the design and perform ance of the instrument. The most notable achievements to date are the three magnetic super-microscopes completed since the spring of 1939—one in Canada, one in Germany, and the latest in the United States.

Figures 3, 4, and 5 were taken by the Canadam instrument and give hints of the new world into which the electron moreoscope affords view Figure 3, showing a resolving power better than 30 angatroms and a useful magnification of 5,000 diameters, so not of the best electron microscope photograph so far published Devigned by Hiller and Pre bus under the direction of Prof E F Burton of the University of Toronto, the Canadam instrument uses lenses of a radically new design

Last fall the pioneering Ruska and his co-worker, you Borries, developed for a German research institute a microscope with a resolving limit of 50 angstroms, magnifying up to 56,000 times Little word has been heard of its progress since then, but it is capable of ex-

The third and latest super-microscope has just been completed in the Camden laboratories of RCA, an important American center for studies in electron ontics (a field which applies to radio and television as well as microscopes) Intended largely for commercial use, the instrument has been developed under the direction of Dr. V. K. Zworykin. Its designer is Dr L Marton, another pioneer in electron microscopy, and the first to apply it to the study of biological specimens This instrument although it does not differ from the others in its fundamental principles incorporates a number of new features of design and construction. The limit of resolution which can be obtained is at least 50 angstroms

OOKING back now at the lower part of Figure 1, let us trace the path of the electron beam through the electron microscope more in detail. The whole instrument is enclosed with air-tight fittings and pumped free of any gas which might interfere with the passage of electrons. In this high vacuum, the cathode, F. and anode behave something like a radio or thermionic tube. The cathode-a metal filament or coated metal plate-is the source of the beam, emitting electrons as it is heated by an electric current. The anode is a metal plate kept at a high positive potentialperhaps 50,000 volts-which attracts the electrons and accelerates them to a high speed A tiny hole in the anode lets through a parrow beam of these 50,000-volt electrons (wavelength: 055 angstroms! The magnetic lens shown in cross section at Li concentrates the spreading beam into parallel rays that fall on the object at 4B

The object—suppose it is the diphihe roof bacillus of Figure 4—has to be supported somehow, and its support must he so that his dipose in the received have been also been also

As the beam falls on the specumen at Bn in the lower part of Figure 1, some of the electrons are absorbed and some are scattered, in proportion to the thickness or density or other properties of the various parts. The transmitted electrons correspond to light of varying intensity reflected into your camera by an object you are photographing, these are what produce the areas of light and shade on the film, and constitute a negative of the final picture.

The transmitted electrons pass on through the magnetic lens L_t to form a somewhat magnified image of the bacillus at A'B'. In the early stages of the

microscope, this was the final image and the one that was photographed. But, as the instrument was improved, another magnetic lens (L_t) was added to give still further magnification

The final image at C'D' is usually photographed, but under certain circumstances can be seen visually. If a fluorescent screen is placed at C'D' the electrons impinging on it cause it to glow in the pattern of the image. This can be observed through a viewing window cut in the wall of the microscope. By watching this picture, and moving the specimen, it is possible to search for interesting organisms or structures. If one of sufficient interest is found, it may be photographically recorded for closer scruting by merely lifting the fluorescent screen out of the path of the electrons. so as to allow them to fall directly on the photographic plate. However, since 02 cm is the limiting size of objects seen visually, and if the fluorescent screen is used, the microscope must accomplish the whole useful magnification without any supplementary optical enlargement to clarify details

It is mute possible to use the cathode tised as a specture, and let it take a picture of itself with the electrons it is emits as it is heated in a vacuum. In this case, no object is put between the acthode and the photographic polate. A similar optical example would be to photograph the hot faliament of an electric bulb with an ordinary microscope, tuning the light of the bulb for illumination. Very valuable studies of the sur-face structure of various cathode metals

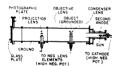


Figure 7. An electron microscope which uses electrostatic fields instead of magnetism to bend its rays

have already been carried out, with series of electron microscope pictures showing how the structure changes as the cathode is heated to different temperatures.

It has been stated that either magnetic or electrostatic fields may be used as lenses. Thus far we have chiefly discussed the magnetic model, which is at present the type most used for high magnifection studies of specimens which do not themselves emit electrons. The electrostatue microscope has not in the past recoved as much attention in spite of the fact that it was first developed (by Brüche and Johannson) about the same ume as Knoll and Ruska began working

(Please turn to page 32)



MIHLI DIG.

Conducted by F. D. McHUGH

COAL AND KILOWATTS

W HILE three to five pounds of coal wat hour of electric power 20 years ago, points out M. W. Smith, wee president of company, though the company, though the company, though the coal consumption of some of the new high-pressure, most sold the coal consumption of some of the new high-pressure, the coal consumption of some of the new high-pressure high temperature steam turbus generating stations as less than one pound per kilowest hour "Other means of power generation," he added, "are now being considered which show the theoretical possibility of cutting in half even this low value of fuel consumption."

CARBOLOY EXTRUSION

PROCESS

CARBOLOY cemented carbide now can be produced in the form of tubing, spirals, and round or shaped bars by means



Carboloy in many shapes

of an attruson process, it was announced recently by Carboloy Company, Inc. Available in lengths up to 20 inches and within the control of th

Contributing Editor

In charge, Daniel Guggenheim School of Aeronautics, New York University

boloy parts are formed directly into the shapes desired, eliminating most of the customary hand forming operations

To those familiar with the limitations ordinarily encountered in working cemented carbides, the Carbolos tubing now produced is of especial interest. This can be made as small as 060° outside diameter by 030° inside diameter, leaving a wall thickness of 015°.

The limitations have been overcome by the development of a new process of extrusion By this process the dry powder is mixed with a plasticising medium and can then be formed by extrusion or molding into almost any shape.

Particularly interesting is a supplementary process, by means of which Carboloy rods, and so on, can be bent to various shapes. The 5 inch diameter ring illustrated was produced through this process. It consists of a round rod curved to form a ring, with the ends joined together

GAGE MEASURES LACQUER

AN electric thickness gage, designed by General Electric engineers, has a fullscale range from 0 to 00007 for measuring non-magnetic coatings on steel and can measure coatings of lacquer only 0 0001 of an inch thick, such as that used in the canning industry on the thin sheet-iron of the cans

This paper, as used in the manufacture of capacitors, and even this electroplatings on steel can also be measured. The gage of capacitors, and depost of 0000 of an inch thickness on ordinary commercial to a measured and heavier contings are measured to a much greater degree of accuracy. To obtain the correct gage expose, the material to be measured must be backed with magnetic material to serve sate the support class returned to serve as the magnetic material to serve.

PREVENTS SHOCK IN SUBGICAL OPERATIONS

S AFER surgical operations and speedier covery from them, especially for debulated patients, seem promised by a new treatment for increasing dangerous shock during and after operations. The hormone, was developed by Dr. David Pela, the hormone, was developed by Dr. David Pela, 19 and 19 and 19 and 19 and 19 and 19 are period by Dr. David Pela, by Dr. Perla, who said that the treatment will shortly be adopted in two other New York City hospitals

The patients treated at Monteñore were what would be considered poor surgeal risks because serious chrome illnesses such as cancer and tuberculosis had weekened them so that they would have little strength to withstand an operation. With the new treatment, patients are prepared for opera-



Non-magnetic coatings on steel are accurately measured with this set-up

tion by being given quantities of salt solution and carefully prepared doses of desoxycorticusterone sectiste. This chemical is the synthetic with formone of the adrenal glands. Earlier studies have shown that these glands play a sagnificant role in the body's fight against intorcations, possons, shock, and infections. The adrenal cortical hormone, Dr. Perla explained, influence the transfer of water from tresses to cells and the level of salt in tissues and rells. Disturbance of this glandular balance, which frequently occurs in an exhausting operation, leads to collapse—Screece Serree

scoot

TANKS between the rails from which railroad locomotives scoop up water without coming to a stop were first used in 1872

FADE-PROOF INTERIOR

FINISH

THE Wood Conversion Company has just amounced Kolor Fast Nu-Wood as an improvement in invulating interior finish. This new product is the first of its type for which fade proof qualities are claimed. These claims are based on severe tests by nationally recognized laboratories, which tests have established the light fast qualities.

Nii Wood Kolor Fast is available in tile and plank in variegated and ian colors. Nii Wood Kolor-Fast Board is available in tan The colors are richer and clearer than he fore. The over-all colors are slightly lighter, groung the material a higher light reflection value in keeping with the modern tendency in interior decoration.

Heretofore, all insulating interior finish board materials have been subject to oxidization which resulted, over a period of years, in darkening of the material

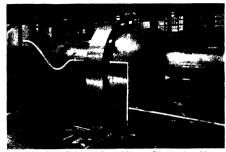
ROD-LIGHTS FOR INDUSTRY

SERMIGLY there is no end to the light transmitting uses of Lurier Sometime ago we discussed in three pages new flash lights for medical examinations which used Lucite rods to carry the light into such those spaces as a patient's throat An arcompanying illustration shows a number of new forms of Lucier flash light developed by Dr. D. L. Weiss for wide use in industry and repair work.

Dr Weiss's development makes use of a small fountain-pen-size flash light, or a handle of the same shape connected to a



Light-conducting rods of various shapes used in flashlight (center)



Alcohol, cooled by dryice to 40 degrees below zero, Fahrenheit, is used for strinking the bolts in this water-power coupling assembly so that they may easily be removed from their carefully fitted holes. The assembly shown set up in the shop of Allin-Chalmers Manufacturing Company, is a huge coupling for connecting the water wheel and generator shafts of one of the three 30,000 key generator units for Chickamanga Dam. The tank containing the drivice and alcohol may be seen at the left. In assembling such couplings, the bolts are first shrunk by placing them in 3 but containing dry ite.

small transformer which, in turn, is plugged into an alternating current socket

Various types of this new unit, called Ang-Lite, are being used in many manu facturing operations to examine assembly of complicated apparatus. The light travels down the Lucite rod and is thrown off in a bright spot at the tip Instrument makers and repair men can examine with these units parts of their equipment difficult to One type, having a rubber-mounted get at magnifying glass, throws a light directly on textiles, printing, or other surfaces to be examined Other forms of these rods, fluted spirally in order to throw a glow of light throughout their length are used for mix ing operations or to observe chemicals in a mixture. In the photographic darkroom Lucite rods of proper color may be used not only as working lights but also as a means of stirring the photographic baths and throwing a glow of light directly on negatives and prints that are being de veloped

NEW WORLD'S RECORD PRESSURES

NEW world's record high pressures, as much as 350,000 pounds per square inch, have been achieved by Dr. P. W. Bridgman in Harvard's Physics Laboratories through use of nests of high pressure vessels in which inside apparatus receives outside support at critical parts.

A piece of tool alloy, Carboloy, composed of tungsten carbide and cobalt, was subjected to a compressive aircs of between 2,800,000 and 3,500,000 pounds per square nich, without fracture Carboloy's crushing strength under normal conditions is not more than 1,000,000 pounds per square inch

Dr. Bridgman, in reporting his results to the *Physical Review*, also made known that under such extreme pressures, carbon in the form of a thin plate of crystal graphite is not converted to diamond at troom temperature. There had been hope that pressure alone might cause the forms too of diamond out of this form of carbon. "It is probable that no pressure, however high, will accomplish the conversion at room temperature," Dr Bridgman now con-

cludes
A striking effect of the extreme high pressures on Larboloy was that, although under normal conditions it is highly brittle and breaks with practically no plassic deformation, under the confining pressures used by Dr Brdgman the piston of this tough material was plastically and permanently shortened by 55 percent with no percentible.

PAINT-RECEPTIVE

ALUMINUM

UNTREATED surfaces of aluminum and its alloys possess no natural affinity for paint, lacquer, or enamel coatings Ordinarily such finishes will not adhere permanently. Use of aluminum has, therefore, been limited to those products on which no coating is desired.

In the Metal Finshing Laboratories of the Pyrene Manufacturing Company a simple process has been developed for the treat mages of alumning so that it will take these finishes. This process, which has proved as strifactory under ordinary plant production conditions and whose flexibility is stricted by the parts with a smirrophone, transmitters, instrument panels, switch parts, has been named the Pylumn process.

Pylumin powder is a mixture of several chemicals which, when dissolved in boiling water, forms a solution that reacts quickly upon aluminum, converting the surface into a non-metallic film of complex basic oxides, thereby forming a coating which is highly resistant to corrosion and also serves as a



Grumman Sky Rocket, designed for operation from naval aircraft carriers

se for paint, lacquer, or enamel finishes Pyluminized metal is of a uniform gray to black color, depending on the composition of the metal treated, and is velvety in

The Pyluminizing operation involves only the simple immersion of parts in a heated solution in a steel tank. The processing action is fast, requiring only three to ten minutes immersion in the boiling Pylumin colution

FIRST TESTS OF THE GRUMMAN "SKY BOCKET"

THE construction of the Grumman Sks Rocket—the XF5F-I, to call it by its Navy designation - was undertaken by the Navy Department well before the war broke out in Europe, when it became apparent that high performance fighters with long range and endurance would be required to accompany heavy bombing airplanes on long flights The European war confirmed the Navy's viewpoint. Long range bombers operate best if supported by fighters of

equal endurance. The XF5F-I is a carrier-fighter and has the control, maneuverability, and relatively small dimensions necessary for operation from the deck of an aircraft carrier. Al though it is equipped with two Wright engines of 1200 horsepower each, it has a gross weight of only 9000 pounds, and a span of only 40 feet. The square wing tips and the square tail surfaces are intended to increase production possibilities without detracting from aerodynamic efficiency

Although the new ship has been released for sale to the French Air Commission, definite information regarding performance is lacking. Take-off occurs in about seven seconds. In one of the tests the Sky Rocket flew about 100 yards in advance of a standard pursuit and suddenly began a steep climb which the older craft was unable to duplicate. Climb was said to be 4500 feet a minute without full power. Top speed is reported to be 450 miles per hour, a figure which is at least plausible. It is noteworthy that the two Curtiss controllable pitch propellers of 10 feet diameter totale in opposite directions. We have often in these columns pointed out the desirability of twin engined propellers turning in opposite di rections. Both control and stability, and the

aerodynamic efficiency, are improved there by. Altogether, there is no doubt that the new machine will be a worthy and gratify ing addition to the air equipment of the Allies -A K

A PLEA FOR MANY SMALL LANDING FIELDS

N a recent speech, Robert Hinckley, Chairman of the Civil Aeronautics Au thorsty, deplored the short length of time that the private owner keeps his ship before reselling it Four out of five of the men who buy private planes sell them within a period of two and one half years, and do not buy other planes. One third of such owners actually dispose of their craft in one year without purchasing another. This is a deplorable situation and in sharp contrast to the case of the automobile, where a man who has once owned a car will mortgage his home if there is no other way of buying a new one Mr Hinckley thought that the situation was due to a combination of sev eral factors, possibly too many log books and inspections, possibly too few small air ports and landing fields

The lack of small landing helds is indeed a very important reason. At least so thinks lerome Lederer, well-known Chief Engineer of Aero Insurance Underwriters not resist quoting part of what Mr Lederer had to say at the North Central Regional Planning Conference. "At present the pri vate pilot may be likened to the owner of a little sailboat in a stormy area with very few harbors to run to for safety Only the more venturesome will dare to risk a sail along the forbidding shore . . If only there were small inlets along the shore, not necessarily

large harbors, these less venturesome folks would try coastwise sailing too, and have more fun Likewise, the private pilot does not want large airports Small landing fields located at frequent intervals in every direction would furnish much greater incentive than now exists to make cross country flights. These fields would furnish men much more chance of getting down safely if bad weather were encountered, besides giving the private pilot greater opportuni ties to use his airplane"

La Guardia Airport has been criticized

for charging large landing fees. We believe that the authorities of this Airport are perfectly right in so doing. Promiscuous use of the transcontinental airports would make air traffic control difficult and increase haz What is needed is a nation-wide movement for a multiplicity of small fields, and every reader who can in some manner encourage the construction of such fields will be a welcome ally to the cause of pri vate flying .- A K

THE FIRST CENTRAL AIR

TERMINAL

N a personal interview with Floyd Del Brown, architect and President of the Bethlehem Engineering Corporation, we ob tained details of the new central air terminal which is being constructed on the site of that famous and friendly old hotel, the Belmont, just across the way from Grand Central Station, New York City The terminal is a splendid example of what Amerian brains, business men, architects, and ngineers working together can do in combining functional design with desirable sober beauty

The artist's drawing of the new terminal building shows its dignity and beauty Five companies will have their offices and pas enger facilities within the one structure-W A, United, American, Eastern Air, and Pan American The building cost will be \$1,500,000, on a piece of land estimated at some \$5,000,000. Tenancy will be for a period of 10 years, the air transport industry is growing so rapidly that a structure twice as big as Grand Central Station may then become necessary

In the new building there will be a base ment for garage purposes and another basement completely fitted as a passenger terminal On the first floor there will be a motion-nicture theater and stores, with the mezzanine used for ticket reservations and so on The second floor will be the main departure terminal The third and fourth floors will house the offices of the five airline companies

The main hall will be three stories high,



New York's central air terminal

160 feet in length, and 100 feet in width There will be six platforms side by side, with hydraulic platforms for raising the pas-senger buses Passenger coaches will discharge passengers at the incoming terminal. proceed to the garage for minor attention. and will then roll on to the hydraulte lifts and be raised to the departure platforms A minimum amount of attention will be re quired as doors and elegators will all oper ate automatically. The whole will constitute a remarkable system of "uniflow," as the engineers call it in steam-engine design. Not only will there be a minimum loss of time and a minimum expenditure in handling coaches but there will be avoided the sorry spectacle of airline coaches parked along the street near some small and insufficiently equipped ticket office as at present

The building, which runs from 42nd to 41st Streets, will have its bus exit on 41st Street With but three blocks of city traffic. the coaches will then be at the entrance to the Third Avenue Long Island Tunnel Then Oueens Boulevard and La Guardia Airport will be within easy reach. It is estimated that no more than 20 minutes will be re quired for the entire trip -A K

HAND CRENADE SAFETY

THE layman will not think of humani-tarianism in connection with a hand grenade Yet that is the essence of a new locking device for hand grenades developed by Norwalk Lock Company, Division

of Segal Lock & Hardware Company, Inc. Often a soldier has occasion to pull the pin from his hand grenade many seconds





or perhaps minutes before he may need it - in a charge against enemy trenches, for example. Should be then find that the trench already has been mopped up, he must dispose of the hand grenade somehow. for the minute he releases his grip on the metal handle, the firing pin snaps over and in five seconds the grenade explodes. Only too often have soldiers been blown to bits by their own hand grenades

The new development consists of a metal collar around the neck of the grenade. A projecting arm is so bent that a slight turn of the collar with the thumb of the hand holding the grenade pushes this arm around to hold the detonating cap holder in cocked position. A number of fine on the collar provide a positive grip for the

TWINS MORE LIKELY TO OLDER PARENTS

F you are an expectant father, your If you are an expectant tanner, you chances for having twins instead of one son or daughter are greater with each year of your age it is revealed by a statistical study conducted by the National Institute of Health and reported to Human Biology by Drs J Yerushalmy and S E Sheerar

Older mothers are more likely to give birth to twins than are younger wome And twin births occur with much greater frequency in families already large than they do as first or second births.

But the fact that older fathers are more likely to have twins cannot be explained by the fact that older women are more likely to have older husbands. When only the births to young mothers are considered, there is still a steady increase in the proportion of twin births to total deliveries with advancing age in the father.

The influence of age in father and mother and order of birth, although showing up clearly when all twin births are considered, seems to apply principally to the births of non identical twins, those resulting from a double evulation rather than the dividing of a single egg cell - Science Service.

PULLMANS

A N average of approximately 32,-000 persons sleep every night in Pullman berths on American railroad trains

THE PITTSBURGH OF OLD PALESTINE

N our January issue, Director Nelson Glueck, of the American School of Oriental Research, Jerusalem, described excavations at an arm of the Red Sea, which had brought to light a buried city with a smelter in which King Solomon refined his copper A second season of excavations at the same site has revealed that there was a much more extensive system of similar refineries than had previously been expected. Indeed, practically the entire town of Ezion-geber proves to have been a phenomenal factory site, of a nature unparalleled in the history of the ancient Near East, according to the same archeologist writing in American Journal of Archeology

FLOWER WATERING GAGE

A NEW and inexpensive device for de-termining the amount of moisture required by potted plants and by seedlings in seed flats has been introduced by Fabaco Company, Inc Known as the "Soil Rite" watering gage, it is placed in pots or flats deeply enough so that its point is in close proximity to the roots, thus registering the degree of dryness or moisture at that depth on a scale Acting as the 'voice" of the plants, this gage takes the guesswork out of watering, a problem that has been the death of many a plant. A



Soil-moisture indicator

chart lists some of the more popular des plants, those requiring moist soil, and those hat do well only when the soil is wet, so that one knows the moisture requirements of the more common plants and will not under-water or overwater them - C F. Greeves-Carpenter

NEW SHIPS FOR

MERCHANT MARINE

N May there was launched at the Newport News Dry Dock and Shipbuilding Company, the steamship President Jackson. first of a new series of ships being constructed for American President Lines Round-World Service Other Presidents to be honored by this series will be Adams, Monroe, Jackson, Van Buren, Polk. Haves. and Garfield

These new ships will be of 9300 tons gross, 492 feet long, 695 feet beam, and have a speed of 16.5 knots

LARGEST WOODEN BEAM

AN accompanying illustration shows the largest laminated wooden beam ever built This beam owes its existence to Laux Self-Bonding Glue with which it was fabricated in the plant of the Speedwall Company in Seattle

Regular two by ten's of a maximum length of 20 feet made up the laminations in this beam which contains a total of 3780 board feet of lumber Of the self-bonding casein glue, 118 pounds were necessary, while only enough nails were required to insure adhesion while the glue was setting.



There are 3780 board feet of lumber in this 8791-pound been

at the cude, and 32 inches at the center, Weighing 2791 pounds, it is capable of supporting a roof load of 65 pounds per square foot of roof. In our illustration, the heam is being tested under a load of 650 pounds per lineal foot.

PIREPPOAR

THROW all the cigarette butta and lighted matches you want to on a new awning and it never burns. It is woven of fiber glass yarn. Besides being fire-proof, it is ret-proof and will not mildew.

MENDING CEMENT

A LATEX cement, which is being sold aunder the name Liquid Thread, mends fabrics, paper, leather, or leatherette, and adheres to such non-porous materials as glass. Used on fabrics, it provides a heat-proof and water proof mend, and is said to be unaffected by weshing and ironing Liquid Thread is made by Paste Elastic Manufacturing Corporation.

It may be used for joining or binding rugs and, when applied as a coating, it imparts anti-skid qualities to rugs, telephone bases, and similar objects. It also finds use as a general adheave in the office, home, and school

A PROBLEM FOR THE

RESOURCEFUL INVENTOR

THE skin prevents the escape of body fluids Its thickness varies in different parts of the body It is freely movable in some places and tight in others, and the creases mark where it is bound down It has mnute ridges which improve the grip on the palm and sole and marvelously sfird the only permanent and absolute means of personal identification with finger prints

With all our modern ingeniuty in reast, in grachiners and fabrics, we cannot create a tough yet highly elastic one that will withstand heat and cold, wet and drought, microbes, and the wear and tear through the wears and yet make its own regainst and even assemble in summer a protective pigment against the suit rays. The skin is a regulator of body temperature, an excretory of our sense organs. The skin helps to form the ear drum, it covers the eye ball, from it originate the teeth, and in it are millions of tiny glands. Finally, when suited in the skin produces vitamin D.—dorand of the American Medical Associations.

ROSES TREATED WITH

GAS FROM APPLES

ARTIFICIAL autumn can be brought to Artificial to their leaves in a few days, by locking them up in the same room with applies, it has been discovered at Oregon State College by J. A. Milbrath, Elmer Hansen, and Prof. Henry Hartman.

Ordinarily such defoliation would be undesirable, but when large numbers of fieldgrown rose bushes are being prepared for shipment to market it is necessary to rid them of their leaves, to out down water loss

HOW WE SAVED

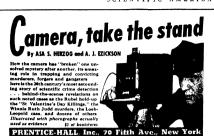
Pandora's Life

by Westinghouse



- If you have been one of the millions of visitors to the New York World's Fair you, of course, know that Pandora is the name of the cute Panda playing such a star role at the Exposition.
- Spectators who cround around her cage these days little realize that if it hadn't been for the quick action and resourcefulness of our air conditioning engineers they might never have seen this rare animal that was brought all the way from the Himalayan Mountains.
- While recognizing that there was quite a bit of difference between the climate of Pandora's home land and that of Flushing Meadows, those in charge hoped that she would be able to adjust herself to the change. But she just couldn't.
- What happened was that she refused to eat or perform; and it became quite evident that she would probably die unless something was done about the weather in a hurry.
- With no time to lose, our air conditioning engineers were called in and asked to duplicate the cool, stimulating climate of Pandora's

- native habitat. So well did they succeed that immediately she started to perk up, and in no time was her playful self, keeping the crowd in uproars with her antics.
- This is just one of the hundreds of air cooditioning problems that have been put up to our engineers.
 Generally, when a person thinks of air conditioning he thinks of it in terms of making a home more comfortable, or of seeking escape from summer heat in a restaurant, store or theater.
- And yet beyond these now commonly accepted uses you'd be surprised to learn what a varied role our air conditioning is playing in industry.
- · Taking just a few examples at random, we are reminded of the way our equipment helped a pharmaceutical house to step up the manufacture of pills and tablets; of how we aided another laboratory to hasten the cooling of creams and salves for quicker packing. Or take rayon, for example-its manufacture would be almost impossible if it were not for the part air conditioning plays in the drying of the fibres. Air travel, too, is a lot safer because flying instruments are now calibrated more accurately in air conditioned rooms.
- Naturally, to produce air conditioning for such a wide variety of applications requires engineering skill of the highest order, plus a range of equipment which extends in our case from a small self contained home unit to a 100 ton compressor.
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through evaporation. Hand plucking is tedious and expensive — a thorny job at best

Bry putting the bushes in a tightly closed, moderately heated room, with one bushel of apples to every 300 or 400 cubic feet of space, they can be caused to shed their leaves in about four days. The apples produce this effect herause they give off small quantities of chylene, which is also a common constituent of natural gas—Science Service.

METAL NIBBLER

PORTABILITY, speed, and power are characteristics of a new portable nibbler with which all types of sheet metal products may be cut into odd shapes for fitting. This new Thor nibbler cuts panels,



sheets, or tubes up to 18 gage in steel and up to 15 gage in aluminum. It follows line or contour accurately, cuts plain or corrugated stock and will cut tubes as small as 1½ inches in diameter. Operated with one hand, it will not distort the sheet and makes inside cuts easily.

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in placing this solvent on the market, USI has made it possible for manufacturers of cleaners to offer a highly effective

All that is needed to manufacture the finished compound is to didute the new solvent with water. The final compound may contain from 15 to 50 percent by volume of the solvent, as desired Even the 15 percent mixture is safe for storage in cold weather.

The 50 percent dilution, it should be noted, will affect paint, varnish, and lacquer, and will soften celluloid (such as eve-glass frames). The 15 percent compound, however, may be used safely on such surfaces and is an excellent polish for eye glasses.

NAVAL CONSTRUCTION

Launching of the battleships North Lacardina and Fashington, early in June of this year, marked the first launching of a battleship by the United States since the early twenties Both of these ships should be ready for shakedown trials within another year. The keels of three other battle-ships—South Dakota, Indiana, and Masse.

chusetts—were laid in 1939, and the keel of a fourth, the Alebama, was laid in February 1940 Two others, the Jowa and New Jersey, have been let on contract to the New York Navy Yard and the Philadelphia Navy Yard, respectively, and their keels will probably be laid shortly, now that the North Carolina and **Earthington are off the ways

As of March 1, 1940, progress of other naval construction in navy yards and private yards was as follows

Two surcraft carriers were under construction, one of which, the Wasp, has since been placed in service. Contracts have been let for six light crusers, for one of which the keel was to be laid late in March Four teen submarines have been ordered, of which two were launched, two were scheduled for launching in March, and the keels had not been laid for three Keels had been laid for all except two of 27 destroyers Nine of these have been launched and two others were scheduled for launching early in March Keels have been laid on most of the remaining ships comprising tenders mine sweepers, a repair ship, a mine layer, submarine chasers, and a large number of motor torpedo boats. Of these, two DD tenders, a fleet tug, a submarine chaser, and two motor torpedo boats had been launched

LABEL GLUING MACHINE

S HIPPING rooms of factories, stores and slow but always messy job—that of pasting shipping labels on packages. Pre gammed labels are not only difficult to handle but are expensive. The Glue Fast Equipment Company, Inc., has worked out a simple gluing machine which operates like many well-known mousteners but which makes



unnecessary the pregumming of labels. This machine covers the surface of the label with a thin film of glue

The operator of this machine uses only one hand to slide the label under the guide bar Pulled across the roller, the label is gummed so that it can immediately be spread on the package and there is no necessity for wiping off excess glue—there is no excess.

LEATHER ELECTRO-PLATING

THE fad of electro-plating babies' shoes to preserve them, and the manufacture of certain kinds of metallic decorative leather, make the following formula of interest to many of our readers

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This process can be used on wood, plaster, flowers, and other such objects, according to the magazine Metal Industry

NEW MAGNET FOR

MEDICAL USE

A NEW magnet for the removal of metal fragments from the eyes and surface wounds has been devised by the General Electric Research Laboratory in Schenectady. Though not designed to replace the



powerful electromagnets in this field, the new instrument is more powerful and more easily handled than earlier permanent magnets used for the purpose. Sintered alnico, an alloy of aluminum, incled, cobalt, iron, and copper, is used with a high permeability insert of nickel-iron to collect the flux at the point. The magnet is light in weight.

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To PROTECT RUSTED FENCES

RUSTED fences present a difficult paint-ing problem. First of all, it is practically impossible to remove the rust and prepare the surface for ordinary types of paints. Furthermore, the links "chafe" the touching pieces of wire and cause the paint to crack and chip away. A new product, Fence-Bond, made by the Skybryte Company, solves these problems.

Fence-Bond is a factory-mixed, ready-touse aluminum paint specifically designed for painting rusted fences. The factory mixing is said to result in a more uniform dispersion and a more silvery, lustrous surface that will protect the fence despite rust that may be present before the repainting. Chafing and cracking are prevented because the paint remains plastic enough to take up all movement from expansion and contraction or other causes.

KIDNEY EXTRACT FOR GASTRIC ULCER

HOPE for stomach ulcer patients ap-peared in a discovery announced at the recent meeting of the Federation of Ameri can Societies for Experimental Biology For these patients there will be the new hormone urogastrone, obtained from kidney excretions. First trials on 10 normal persons showed that this hormone can stop the

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TH ROSICRUCIANS Note (AMORC) CALIFORN [Not a Religious Organization] CALIFORNIA formation of acid by the stomach, Drs. A (Ivy, E Wiezcorowski, and J. S. Grav. of Northwestern University Medical School. reported At present, ulcer patients must take alkaline powders to neutralize the acid in their stomachs so that it will not irritate the ulcers and cause bleeding

The new hormone will be injected under the skin Such injections at present cause swelling and reddening. Dr. Ivy and asso crates hope shortly to overcome this feature by further purification of the hormone, after which it will be ready for use in treating ulcer patients. The hormone treatment, by checking the acid in the stomach, will give the ulcer a chance to heal -Science Service

ACAR

IN dried form a grayish, light, stringy solid, agar is made solely in Japan because the harvesting of the seaweed from which it is made, and the processing, require much hand labor, which is cheap in that country Should the supply be interrupted, all manner of research institutions would be handicapped, for it is used almost invariably as a culture medium in research involving germs.

MACHINE POST OFFICE

COIN-OPERALLD post office, called A the Mailomat, has been intriguing commuters and others, with letters to mail at the last minute—in both of New York's great railway terminals. This machine is, in reality, a self-service post office, for if the letter is dropped in with a coin the machine prepays postage and postmarks the letter No stamps are necessary and it is not necessary to run the mail col lected from this box through the cancelling machine at the post office. The Mailomat Meter Company

OFF WITH PEANUT SKINS-CHEMICALLY

BEFORE peanuts can be used as a food, the unpalatable reddish-brown skin which closely covers the nut must be removed This has been a problem in the manufacture of pranut products Home economists in the Department of Agriculture now have developed a commercially practical way to remove the skins with low weight loss and no splitting, and still have a nut high in quality. The shelled nuts are dipped in a 1 percent hot lye (sodium hydroxide) solution for about eight sec onds just long enough to moisten the They are then dipped immediately skins into a cold. I percent solution of hydrochloric acid to reset the dissolved pigment in the skins and thus keep it from staining the nuts. The nuts are then runsed in cold water and the skins easily removed by hand. The nuts are dried at room temperature before storage

Peanuts skinned in this way retain their smoothness and gloss and keep much longer than those blanched either with hot air or hot water. The weight loss is low - 3 to 6 percent as compared with around 18 percent for the usual commercial hot-air treatment.

SEEING WITH ELECTRICITY (Continued from page 22)

on magnetic lenses. The principle of this type of instrument is shown in Figure 7, a diagram of an electrostatic electron microscope now under construction in the Camden laboratories of RCA. Here radially symmetric electrostatic fields between suitably shaped apertures serve as lenses. While the actual construction of the instrument is quite different from that of the microscope described, the operation is quite similar These electrostatic lenses now appear to be capable of the same high magnification as the magnetic lenses, but the ultimate resolution that can be obtained with them has yet to be determined

We could hardly leave the subject of the electron microscope without giving at least a sketchy account of some of the difficulties which beset it Any microscope, optical or otherwise, is allergic to certain "bugs" in the works, some of them inherent in the illumination itself, and most of them lead ing to distortions and aberrations of the

Among these is diffraction, which we have already mentioned, explaining how it limits the resolving power and tends to blur the image. But present-day electron micro scopes still have a long way to go before they attain their theoretical resolving limit of half the wavelength of the electron Even so, the fact that, for a given specimen, diffraction effects decrease with wavelength, gives the electron microscope an advantage over the optical instrument. As large a part of that theoretical advantage as can be ex ploited practically is being sought for use

Figure 5 is an electron microscope photo graph of the edge of a new razor blade, magnified 24,000 times. The section of blade pictured is 00003 cm (about 1/83,000 inch) across a distance within the scope of good optical microscopes But, had the latter been used, diffraction would have blurred the indentations of the edge, and the picture would lack the detail and ex quisite clarity of line given by electrons

With present electron lenses, a number of errors other than diffraction are of great importance, and keep the resolving limit far above its lowest theoretical value. Distortions of the image result if the electric or magnetic field lenses are not perfectly symmetrical or constant, if the accelerating notential varies even by a volt or two; or if the velocity of the electrons is slowed too much by passing through the specimen and its mounting Once again, each of these electron lens errors has an analogue in optical lenses spherical aberration, chromatic aberration, astigmatism and so on

The proper mounting of all types of biological and physical specimens also presents a problem which is at present far from being solved. The men working on it have been successful in mounting a number of types of bacteria, colloidal particles, and other physical specimens, but the extension of the list and the interpretation of the images is more difficult. However, when one considers that, after a century of work, the corresponding problems of light microscopy are far from complete solution, the development of the super-microscope and its associated technique appear almost phenomenal

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

OPTIMUM is the word to characterize the Richest Field Telescope, which affords a optimum broad view of the heavens

"I enclose a photograph (Figure 1) of a 6", short-focus reflecting telescope made for me by two friends, W F Gale in the chair " writes G H Hoskins, of Ewarra, Brewongle, New South Wales, Australia "My interest was aroused by a chapter on The Richest-Field Telescope,' in your book,

'Amateur Telescope Making-Advanced The telescope is 30" long over all, focal



Figure 1 RFT made in Australia

length is 24", mirror is 6" diameter. Rams den eyepiece, magnification 19 diameters, field of view 2°

"It struck me, when suggesting its construction, that the design could be made more comfortable to use, hence a leather covered pad was attached to the base, so that the telescope could sit easily on a rather bony knee-it also helps to take up vibration. The evepiece is just at the right height when one is sitting in a chair A door handle is attached to the tube, to allow safe carrying, but it also gives a remarkably steady hold when observing—the telescope is steadier than a binocular Another part of the apparatus, and a most useful one, is the alt-azimuth mounting shown. This

is extraordinarily good
"I have used telescopes, up to 18", but in none of them have I seen such compre hensive and beautiful views of the heavens As a comet seeker it would be hard to find its equal and, for ease of use, I know of no other unmounted telescope to approach it All thanks to 'ATMA'"

Thanks mainly to S. L. Walkden, father of the RFT .- Ed.

E NDLESS and largely futile has been the

the refracting telescope and those of the reflector After years of near ostracism by American amateur telescope makers, the refractor is now in the social swim, thanks largely to J. R. Haviland's lengthy and detailed treatise in "ATMA" An amateur whom we shall designate as X because he prefers to be anonymous has completed a 714" refractor (Figure 2) and says he enjoyed the job, also likes the telescone

X says he feared to begin the 716" oh jective lens as his maiden refractor job but, after a talk with J R Haviland, he felt encouraged to wade in The 8" flat required in testing the objective, good to a quarter wave, was successfully completed in 150 hours. Then came the actual object "It definitely was not difficult." states X. "The edge testing jig and spherometer described by D Everett Taylor, in the February, 1940, Scientific American is the thing However, I found the three-ball ng recommended in 'ATMA' to Haviland was good Using a Starrett gage on the Taylor equipment, it was necessary only to take a little care and use patience to get the crown and flint to radius and the edgewithin the limit of accuracy of the gage This eliminated the bugbear of centering

To evoid scretches I ground glass blanks to the same radius as each curve and used these to break in the pitch lans. Figuring was rather baffling until I tried Ellison's stunt of putting a heated flannel pad in the center of the back of the flint to indicate definitely what a hill should look like, then varying lap and stroke accordingly. To save making King's test for convexes I drew on my flat making experiences and interpreted the fringes against the concave, for this the concave should be a true surface with a clean edge I finished No I surface one fringe off, and No 2 about three off, but this was committed to the concave

The objective required about 225 hours of actual work. It is second grade Jena and of course has some strine (a pair of guar anteed discs would have cost probably five times as much) Strange to say, it is difficult to trace any irregularities to the striac in actual performance though in the col limation tests they stood out like a sore thumb Under test on the stars the glass is quite satisfactory. There is much less scat-tered light in the field than in my reflector The planets and, particularly, the Moon's detail stand up much better under high DOWNE

John R. Haviland, author of the chapter on objective lens making, in "ATMA," states that he has tested this objective against his 10" flat, and that it tests firstclass and has a beautiful polish. The anonymity of X is not of his own choosing. it isn't due to shyness, and the G-men aren't after him! Your scribe will forward to him private letters from readers, if addressed in care of this department

William R Harlow, 328 Fisher Hall, Oxford, Ohio, states that he made a 7%" objective lens, working from Haviland's chap-

ter in "ATMA," which he praises, the job lasting from November to May "The bicon vex crown part was easy," he says, "but I had trouble with the back surface of the flint. The unit was quite a bit over-corrected and had to be separated by about 0.1" definition of the image then was somewhat spoiled by the light reflected back and forth between the surfaces. All in all, the lens is all right," Harlow continues, "but I will stay with smaller ones after this."

A 3" is usually about the best size objective for a maiden job, (at least one previous reflector having been made) One man followed this by a 414", then a 6", obtained good results from all, and has used nothing but these refractors for the past several

SILVERING isn't extinct, by any means, even though aluminizing today seems superior From C 5 Walton, 5975 W 44th Ave. Wheatridge, Colo., we recently re ceived word that a method of silvering described in The Philosophical Magazine (London), December, 1938, pages 953-970, had been successful in his hands and that he believed it had advantages over the more familiar method. On the basis of its origins, also of Walton's praises, we asked him to describe it, which he does as follows

"My attention was directed to an article n silvering in The Philosophical Magazine. December, 1938, written by B Dasannacharva and Amar Chand Seth, of the Hindu University, Benares India, which seemed o offer unprovements over the familiar Brashear method Trial met with success, so I pass the method and my experiences

"Clean and prepare the mirrors according

to the methods stated in 'ATM "Prepare two sets of solutions based on gram of silver nitrate in 21/2 oz. water, 1/2 gram potassium hydroxide in 1 oz. water, and 6 cc regular sugar reducing solution for each 175 square centimeters of area.



Figure 2. The anonymous refractor

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including a dish, if any. An 8" sairror, for example, having 314 sq cm. of area, with a band around it, would be silvered by preparing two solutions, each made of 2 grams silver nitrate in 5 oz. of water, 1 gran potassium hydroxide in 2 oz. water, and 12 cc. reducing solution. The water happens to be an amount that will cover an 8" ror properly. The two gentlemen of Benares state that the concentration is not important. but that the relation of silver nitrate to area is. They found one gram to 525 sq. cm. to be the best, but with prolonged depositing time I did not get a sufficiently heavy coat and preferred one gram to 175 to 200 sq. cm Other chemicals are, of course, always maintained in the usual ratio to the silver nitrate. Two applications on the basis described will produce a heavy coat.

"Clear the silver nitrate solutions with ammonia, as usual, add potassium hydroxide solution slowly, stirring constantly; clear again with ammonia, very carefully. The solutions clear decisively and there will be no turbidity, sediment or black suspended matter left. They therefore need no filtering

"Forget the reserve nitrate solution and the instructions to have silver in excess The authors state that the worker should just clear with ammonia each time, and that, in the second clearing, a slight ammonia excess (a drop or two) may be desirable since the coats will be more free from spots and action will be retarded to a convenient rate. Further, they say that tem perature is of little importance. I can subscribe to the workability of all this.

"The solution on the mirror, to which reducing solution has previously been added, will turn clear brown, then opaque black, then gray, and finally, if left on 10 or 15 minutes, will clear to some extent, and will not form a lot of black muck as it does when using the more familiar methods. Pouring off solutions about the time they turn gray seems to be the divid ing line between a bright surface and too much white bloom. The wet coat may be washed with mild soap and water to remove bloom and sediment—with ressonable care of course

While I use two applications, I do not deliberately strive for as thick a coat as results, because thin coats seem brighter and have less bloom, and after five years' experience with various coats on a 101/2" and 12" mirrors, plus a lot of use of the 20" Alvan Clark refractor at Chamberlain Ob servatory, entirely on faint variables and novae which frequently were beyond reach of even the 20", I have concluded that some thing is wrong with the dictum, 'a thick coat is better in every way' However, double coats produce fewer pinholes for me, which soothes my feelings. Moderately thin coats and thick coats reach about the same minimum star magnitudes in my reflectors, and their performance is exactly proportionate to the 20" refractor in that

"In sum, I consider that the improvements in silvering made in India not only save chemicals, but that the process works clean and precise as compared with the circular quoted in 'ATM'"

OR the alt-azmuth mounting a wrinkle usually attributed to the Earl of Craw-ford, and described by S. L. Walkden, of London, provides a fairly good rough working substitute for the drive clock used on equatorial mountings. Figure 3 is self explanatory. Walkden writes: "The scheme can be made to work pretty well for looking southward within about four or five hours o

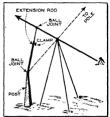


Figure 3. An old alterimeth kink

the meridian and up to about 60° North Declination. It generally works suitably enough for about an hour's observation. If the eye end of the telescope is slightly over weighted, a cord may be substituted for the extension rod"

N "ATMA" Everest describes the use of IN "ATMA" Everest describes the use of kerosene in place of water for mirror grinding, since the cooling caused by evaporation of water causes temperature effects well worth taking note of in advanced mir-ror making W A Mason, 1303 Lakeview Avenue, Lorain, Ohio, says he has tried instead some carbon tetrachloride, also "Prestone" anti freeze, diluted about 1 to l, and believes these are better than kerosene-though he states that he has used them on only one mirror, hence does not wish to make this claim dogmatically. He also diluted "Prestone" anti-freeze 1 to 1 with rouge and thought it kept the rouge mixture on the lap better than water, also retarding evaporation Mason is the author of a chapter in "ATMA" (p. 361) "Prestone" anti-freeze used in automobile

radiators, and known to everybody, has an ethylene glycol base and suffers practically no loss by evaporation. In a 1 to 1 mixture of "Prestone" anti-freeze and water, the evaporation, at ordinary temperatures, would be approximately one half that of water alone

OU invited some friends over to spend Y OU invited some triends over to specific the evening looking at the stars through your telescope. They came-whereupon everything clouded up. The friends hung clouded up to hours, givaround through an awkward two hours, giving you the dog-eye, as if it were your fault, and you felt like a plugged mckel Then they went home-whereupon all the stars came out.

It hasn't happened to you?

This total depravity of inanimate ob-ects does not catch W. L. Chamberlain, 519 Liberty Street, Meriden, Connecticut, mapping. He keeps in reserve a dummy telescope made of cardbard tubing, equipped with indirect lighting and an "eye-plece"—a sort of peep-show—and into this tellips and the allips various mounted astronomical pictures, half-tones and drawings from here and there. And he says his friends actually think these look better than the reality!

Well, when you consider that these would be mainly exceptional pictures, corresponding to rare views of the heavens taken with large telescopes, also that most persons who have studied or read no astronomy at all are disappointed when they see the stars through a telescope, because in seeing they see only with their eyes while the amateur satronomer "sees" also with the intellect, then these cut-and-dried pictures probably do look better than reality to your friends, who no deabt would be too polite to say so Of course, one could show such pictures to the visitor even without a dummy telescope, yet there is just enough of the kid in most of us to fall in readily enough with some such guise, just as we do with scenery at a play This saves the evening when guests look reproachful

Chamberlain wasn't, however, the first amateur to try this stunt Holden's biogra phy of Sir William Herschel contains a letter from Sir William to his daughter Carolina, dated July 1782, in which is revealed how Herschel tried it on King George III and his Queen when they came to look through his telescope (George III became a good amateur astromoner later on, even though as a King we Yankees think he wasn't so hot) "When the evening appeared to be totally unpromising," Herschel wrote, "I proposed an artificial Saturn as an object I had beforehand prepared this little piece, as I guessed by the appearance of the weather in the afternoon we should have no stars to look at This being accepted with great pleasure. I had the lamps lighted up, which illuminated the picture of a Saturn cut out in pasteboard at the bottom of the garden wall. The effect was fine. and so natural that the best astronomer might have been deceived. Their royal high nesses and other ladies seemed to be much

ONVENTIONS of amateur astronomers will be held Friday-Sunday, July 5-7, at Buhl Planetarium, Federal and West Ohio Sts., Pittsburgh, Pa., by the Amateur Astronomers Association of Pittsburgh, H. Clinton Kyle, General Chairman, also Saturday, August 10, at Stellafane, near Springfield, Vt., Roy J. Lyon, Secretary All are welcome to both gatherings.

NEWTELLIAN is the name given by John M Pierce, 11 Hsrvard St., Springfield, Vt., to a reflector having a small diagonal just outside the incoming beam of rays, which he has described in one of his hobbygraphs.

ADVANCED optical design sharks will be interested in a 13 page article on "The Design of Wide-aperture Photo-graphic Objectives," by R. Kingslake, of the Eastman Kodak Co., in last January's Journal of Applied Physics (175 Fifth Ave, New York). Trends is the main thread in

ROM The Journal of the Royal Astrolege St., Toronto, Ont., can be obtained, for a quarter, a practical booklet on "The Small Observatory and its Design," by Brydon, who contributed to same journal in 1939 an article describing "Two Inexpensive Drives for Small Telescopes," one drive being especially interesting. Same cost.



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MAKING THE MOST OF YOUR VACATION SHOTS

THIS piece may seem to be more appropriate at the end of the vacation months, when we have all gathered what vacation pictures we are going to be able to make this season. However, though it may seem like putting the cart before the horse-discussing print making before we have shot the negatives—this department would like to submit that many a picture would be much improved if the final print were kept in mind even as one is shooting the original subject

The illustrations reproduced here are the work of Miss B S Shannon, a member of



Figure 1

the London Terrace Camera Club (New York) and represent two of a large number of negatives she made during a trip to Mexico, that land of limitless picture opportunities The sermon that Miss Shannon's pictures suggest for this month is that a single negative may often yield more than one picture, even though a print from the full negative may itself be worthy

Miss Shannon uses a negative format longer in relation to its width than most amateurs are accustomed to work with; as a result, they cannot be enlarged, without cropping, to the usual 5 by 7, 8 by 10, and 11 by 14-inch formats the standard printing papers call for. One of the best examples in her collection is Figure 1, which depicts



Figure 2

two moods in a single scene, the busy mar ket place in the street and the tranquisty and dignity of the church on the hill above Although the two moods might appear to clash, together they present the character istic flavor or "mood ensemble" that we have come to associate with Mexico. As it stands, the picture has definite charm and undeniable appeal. It is very well worth while We like it

However, the negative does lend itself to dismemberment, as Figures 2 and 3 will illustrate In Figure 2 the concentration is in the market-place, in Figure 3 the church and sunlit rooftops occupy the full picture.

Not all negatives, of course, are so easily separated into two or more pictures. In many cases it is difficult to get even one good picture out of a negative which has been that without any sense of composition or appreciation of the fact that a picture must have a point of interest and an arrangement in which the various elements are pleasingly balanced

Another type of negative in which a cer tain effect was desired but which fell flat because of one circumstance or another. is shown in Figure 4. The goal of the photographer was to shape the three persons (plus the baby) into some story-telling pic ture, but things did not work out as desired The baby probably became upset for some



Figure 3



France 4

reason, and the mother and boy had their attention diverted. The only saving feature of the picture is the smiling worker leaning on a shovel. By judicious cropping, an interesting picture was salvaged from an apparent failure.

Despite all precautions you may take and all the care put into the making of a negative, pictures in which persons are included,



Figure 5

and particularly where they are shot candidwise, often will prove disappointing. But do the best you can, always keeping in mind that negatives do not have to be printed just as they are exposed but may frequently be "dirted," as our movie colleagues have it, to produce at least one picture from a piece of the negative, even though the larger por to not it may be worthless. Sometimes, too, we are obliged, by reason of the angle of view encompassed by the lens, to include more than we desire. Again we do the best we can and keep in mind that when we come to making the enlargement later we can take what we want and let the rest to

PREPARED SOLUTIONS VS MIXING YOUR OWN

THE question often arises as to whether it is better to buy developing solutions already made up or to mix one's own solutions. Louis H. Lanctot, A. R. P. S., of the Center Photo Stores, Inc. (New York), re

cently commented on this subject as follows "The only advantage of mixing one's own olutions," he said, "is that it is a little cheaper Sometimes, too, there arises the need for a special formula to do some par ticular work and having a stock of chemicals on hand makes it very convenient. But on the whole there are good reasons why the photographer should purchase his solutions The manufacturer mixes the chemicals in large quantities and this reduces any errors in weighing Again, the mixing operation is carried out in a scientific manner under the supervision of trained chemists and there is no chance for the solution to go wrong The small additional amount ex pended on a prepared solution is the price you pay for a chemical engineer to help you. as well as insurance that your solution will work satisfactorily"

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completely lined their darkroom sinks with it, hiring a local tinemith to do the iob But for the present, however, most amateurs are content to take advantage of the many conventional items now available.

RE FLAT PRINTS

A CURE for those carling prints most of us keep complaining about is offered by John H. Cornwall He says it took him all of his 18 years in photography to discover it, but believes he has the solution now. After washing the prints thoroughly, he infimerses the prints in the following hath.

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He recommends this after rinse particularly in the case of prints that are to be ferrotyped Upon drying, the prints fall off the tins flat and without any signs of the corrugations and non glossy circles that make ferrotyping such a chore and exasperation for some workers

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JACOB DESCIIN, conductor of our "Lameta Angles" department, unit antiern in these columns questions of general interest to amateru photographers. If on answer is desired by mail, enclose a samped, addressedenvelope Queries should be specific, but MP Deschin cannot under to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.—The Editor.

Q. A certain studio turns out portraits with a bronze tone, which gives the subjects in the portrait a very pretty fiesh tone and is subsequently easier to color. Will you please tell me if this tone is achieved by toning? If so, will you please give me a formula and also the type of paper most suitable for this kind of work.—G. G.

A. The photographer in question undoubtrelly uses agold toner Aga Flemish Gold Toner is a prepared product that appears to be generally liked. A good formula is the Nelson Gold Toning Bath (Kodaš 1-72). A variety of tones may be achieved with these toners and you will have to doom experimenting to oldian caselly the broome tone you refer in Chloride or chloride to the control of the control of

Q. Some months ago I bought a ministure camera with a fast lens. The other day I discovered two small marks about the size of a pin point; they appear to be pits on the front lens. Can you tell me what effect this will have on negatives made by this camera? I have noticed no defects on the ones! have made. I photographed a sheet of newspaper and there was no diffusion in any part of the print. Is such a test of any value?—C. E. A.

A The only test of lens performance that is at all useful to the photographic worker is the negative made with it Therefore, if your negative hook satisfactory, the pits you speak of apparently have no effect full confidence. The newspaper lest is a very good one because, containing sharp defeate of the performance of the performance

Q. Recently I cemented in Canada balsam at ricolor gelatin filter set in 40mm glass circles. The red filter is almost perfect, the green filter is very slightly hazy, and the blue filter turned out to be useless as the diffusion lacreased to a point where it gives a double image. I have made two sets of these filters with the same gelatin, balsam, and glass and the order of diffusion is remarkably identical What do you think could be my trouble?—R. M.

A. The difficulty may be in one or more of the following factors: the quality of the diglass may not be good (it should be plate and it is also as described quality), the halam may not be of a good grade; the cementing or the binding of the gelatin between the binding of the gelatin between the bound filler may not have been allowed to dry long enough (it may sometimes take as long as 10 days). If you will probably find the answer to your trouble find the answer to your trouble.

Q. My camera uses 127 film and I have a developing tank for it which uses eight ounces of solution at a time. 1. Do you know of any developer in concentrated form on the market which is prepared for only eight ounces for tank use? If not, do you know any formula for a developer suitable for tank use, which could easily be prepared for only eight ounces at a time? 2 Approximately how many rolls of 127 films will a quart of acid hypo fix, using D-76 developer and leaving films 15 minutes in hypo? 3. Does the exposure or the developing determine the contrast for the resulting prints? In other words, will each exposure on a roll have a different contrast or will they all have the same contrast?-R Ý

A. 1 The smallest volume in which concentrated developer solution is available for fine grain work such as you require is 16 ounces Panthermic 777 is available in eight ounces but only in dry form. Any developer formula can be scaled down for an eight-ounce solution. It is simply a matter of dividing the larger volume stated in the formula 2 We do not have the exact figures, but the general attitude of workers is that, since hypo is so very cheap, why not use it liberally to insure proper fixation? On this basis we would say that up to five or aix rolls for each eight ounce volume should be the maximum 3 Exposure determines the gradation of tone, development time determines the contrast, the longer the development time the greater the contrast, the shorter the period the weaker the contrast. The degree of contrast will be the same throughout the roll.

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PHILOSOPHY

SOME men are, by avocation, carpenters, thy-tyer, mechanics, hottomburists, while others delegate such apecalized tasks to professionals and invest their lessure in various pursuits. It's all a matter of personal preference, and so it is in goin collecting. The collector, or his again, may acquire magnificent specimens through contact with legitimate, trustworthy, antique auctions. For three he may pay large or small sums, and more offers than not the arms which find biomore places in his gain properties.

Not so with Major Lenox R Lohr, President of National Broadcasting Company His gun collecting philosophy begins with



Major Lohr and guns

the personal discovery of a specimen, tucked away in some dark cranny of a junk yard, an attic, an old barn, or other casual source, and ends with the investment of a prodizions amount of elbow grease expended in cleaning, refurbishing, and repairing the brearm in an effort to restore it to as near its original status as possible. Somewhere in between these extremes there has oc curred a bit of keen, good-natured bargain ing which ended in payment of from one to four dollars for the desired specimen, for. save Major Lohr, "Contrary to popular be to begin a firearms collection" As proof of the Major's contention, every rifle, revolver. pistol, and shotgun in his collection is in working order, is capable of firing the load originally designed for it, and his largest investment in any single piece has been \$4 Major Lohr's collection of U S. military rifles, thoroughly reconditioned in his own workshop, has provided him with many hours of pleasant relaxation, knowledge of the details of varied constructions, and the satisfaction of having proved that anyone can pursue the hobby of gun collecting for an insignificant expenditure . In fact, the Major points out, an old gun, purchased for a dollar or two, throughly cleaned and repaired, pars dividends on the investment is being of greater value to someone and by increasing the collector's knowledge of the history and mechanics of firearms through the research, study, and effort expended in creating it May an American Iad, he rectioning it May an American Iad, he harder labor than a involved by subscribing to his philosophy of gun collection.

Outstanding among the Major's frearms as agroup of American military rifes which deport the evolution of the breech loader lands of the Springfield muzzle loader of 1837, converted from a finitheck, an 1840 North parm with rimsus breech for separate loading of powder and ball, a Burnade rifle for separate ball and powder, with percussion cap and tapered breech seal, a Starr infe of 1838, built for paper cartradge, the end of which had to be bitten off to expose powder to percussion cap, an 1829 Sharp's rifle, with percussion cap, an 1820 Sharp's rifle, and percussion cap.

ARE FISH COLOR-BLIND?

T'S an old but ever new discussion as to whether fish are color blind, yet Dr Frank A Brown, Jr., assistant professor of zoology at Northwestern University, recently conducted a series of experiments which would appear to have settled this antique argument It seems the good Doctor caught some bass in an Illinois lake, put them in large, white enameled basins, and proceeded to feed them with pipettes, or common medicine droppers, which had been covered with adhesive tape tinted in various colors The joke was on the fish, however, for from one pipette only did they obtain food All others were electrically wired so that the bass received a mild shock as he nosed into it.

But now came the convincing part of the demonstration Different in hever trained to obtain food from different colored piperies. When the bass had completed their "training period," the experiment began. A deliberate attempt was made to confuse the "training period," the experiment began in new and unfimiliar colors, and various timed and produced the property of the state of the color of the

distinct color a bass sees, followed by green, yellow, black, blue, with black and blue appearing more nearly similar than any other colors. Despite the results of Dr Brown's experiments, there will be many anglers who mass fish cannot distinguish colors and that the use of multi colored lures is merely an attempt to beguite the fisherman, not fish. What do you think?

DUCK STAMPS FOR 1940

THE 1940 "Duck Namm," which must be purchased for \$1 by all magatory water food hunters over 16 years of age, will be available to the public at all 1st and 2nd class post offices July 1 This year's design, by France 1 Jagues, shows a brace of black ducks flying down wind over a marsh area, with wild mee in the background. The area, with wild mee in the background The percent of the money from Duck Stamps sales to supplement other funds for pur chase and maintenance of waterfood refuges, and the remaining 10 percent is used for printing and distributing stamps, administrative purposes of the Migratory Bird Hunting Namp Act, and for other Federal activities relative to magratury but conserts.

TECHNOLOGY IN ROD MAKING

AST month we delved briefly into rod making, mentioning some of the early artisans who were pioneers in the six-strip construction so largely in vogue today With 12 million American anglers wetting lines in streams, lakes, and oceans, however. some of the former handwork on rods must now be done by machinery in order to meet the tremendous demand By no meanshould this be construed to indicate that the niceties of skilled workmanship have been lost through technological advances To the contrary, at the South Bend Bait Company factory, for example, specially de signed machines, so true in operation that variations of 001 of an inch are unknown, convert the split sections of bamboo into one end to the other which later governthe action of the finished rod, it is possible to produce segments which not only are nunutely uniform, but which pass micro metric inspection. Some conception of the exactitude of this machinery may be gained by realization that in some rods 12 pieces of cane are used instead of six, thereby pro ducing a rod within a rod Likewise, the South Bend Bait Company constructs what is known as a "Triplebuilt" rod from 18 laminated segments of cane, and even goes further to produce their Cross "Bow Stave big game fishing rod, shaped from more than 40 flat strips of outside bamboo enamel, laminated and glued under pressure

But the important point to remember is that these sections, or "stacks" as they are known to the tackle trade, must remain in seasoning valles at least 1½ to 2 years before they are finally fashioned into a rod Only after this seasoning period can such hand operations as straightening, cleaning, halancing be done. Each section must befinished to pre-determined calibrations, the control of the understand why a fine rod cannot be turned out in a day?

Pot-Shots

FOX, SAVACE, AND STRUMS 1940 CAIABORS AND STRUMS 1940 CAIABORS are off the press and each presents an array of gune to delapt the hand and eye of the most critical and fastidious guiner. They're all there, from the certerlabilities Servans 22 unigle-abot to the Fox FE Grade, double-barrel shorgum in all tist external constitutions are present taking beauty and symmetry. To mention but a few innovations incorporated in the 1940 products, Fox Model B, madi-duly and the products, Fox Model B, madi-duly and 1940 gages last vasion, is also available this very in All Done, chambered even in All Done, chambered even in All Done, chambered even in the 1940 present in All Done, chambered even in All Done, chamber even in All Done, chambered even in All Done, chambered even in All Done, chamber even in All Done, chamber even in All Done, chamber even in All Done, chambered even in All Done, chamber even in All Done, chambe



for 3-inch shells in 26-inch barrels This hight weight, popular priced, hammerless double met such enthussate acceptance, when brought out last year that additional barrel lengths may now be had The 16 and 20 gage guns come with 20 and 28 inch tubes, while the 12-gager may be obtained with 20-inch barrels.

In the Savage line, new rifle for 1940 is Model 602, similar in design to the "3 way Model 6, except it is chambered for shorts only As an automatic, it will handle 22 short regular or hi-speed cartridges with lubricated bullets, as bolt action repeater or as single shot, it takes any .22 short cartridges The 99-H Carbine, with 22-inch barrel, is now chambered for the 300 Savage cartridge, as well as for the 250-3000, 30 30 and 303, but with 20 inch barrel for last three Model 99-RS is now regularly equipped with Redfield No. 70 adjustable rear peep sight, folding leaf middle and gold head front sight, has 7's inch combina tion adjustable leather sling and carrying strap with quick release swivels Model 40 Super Sporter has checkered, capped, full pistol grip, checkered fore end Models 23-AA, 23-B, (, and D come equipped with % inch sling loops, are likewise checkered on grip and fore end In automatic shotguns, Models 720-P, 726 P, and 740 P have as standard equipment new Aero Dyne Super Poly (hoke built integral with barrel

and Bev-L Blok front sight Model 762 is Stevens' new 1940 offering Comparable in design to popular Model 76, which handles 22 LR cartridge, the new gun is also automatic, but is chambered for 22 shorts The No 620 repeating scattergun in 12, 16, and 20 gages has been redesigned to eliminate upper tang from frame and to provide streamlined frame and stock, which now has full capped, checkered pistol grip Same gun, but known as 620-P, comes with new Aero Dyne Super Poly Choke built integral with barrel Stevens 22 caliber re nesters and automatics are drilled and tapped for Weaver 'scope sights, eliminating factory fitting process Public reaction to use of the plastic, Tenite, on Model 530-M. shotgun for stock and fore end has been so satisfactory that No 22 410, over and-

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SKEET and how to SHOOT IT

By BOB NICHOLS

To the skeet devotee this book will be a friendly, helpful critic in pointing out possible existing faults of form, stance, fit of gun, target lead, and other factors which may have tended to interfere with perfect scores. To the inexperienced skeet shooter it will be a complete and competent guide to the above named phases of the sport, as well as to choice of guns, constructive suggestions and extensive information on eyes and shooting glasses, clothing, field lay-out, and the entire game from station one to station eight. The author writes in clear, graphic style, gained from his own extensive experience in skeet shooting and from his knowledge and background as Arms, Ammunition and Skeet Editor of Field and Stream. (177 pages, 6 by 91/4 inches, 46 illustrations.)-\$3.60 postpaid.

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under combination rifle and abotgun will be similarly equipped later this year. We discussed use of Tentie in Docember, 1993, issue (Vol. 283, No. 6) and have severely tested our own Tente-stooked Model 330-M It not only "shoots sweet," but also can "stand the gaft." The Fox-Savage-Stevens parade of guns is on, and catalogs are available. Which will you have?

AMERICAN OPTICAL COMPANY offers relief to fishermen from dearling sun by filtering out reflected glare rays through that new AO Polaroid Day Glasses, which help to locate his hefore they locate you. With better vision and ability to see the big ones strike, it's easier to set the hook. Skeet shooters, too, should find AO Polaroid glasses of great herefit.

From Inquiries we've had, there must have been something very alluring about Smith & Wesson's new .22 cal target re



volver, "Model K 22 Masterpiece" Here's a picture which will prove it has "oomph", we still have a few K-22 folders

MOHAWK PRODUCTS COMPANY has borrowed a leaf from Galileo and developed a telescopic peep sight as an improvement over standard peep disks on receiver and tang sights Combining two precision ground plano-convex lenses, one of flint, the other of crown glass, Mohawk has achieved a telescopic effect with a field which is bright and free from the blur often found to some degree in peep disk use Total length of Peep 'Scope at normal tocus is just under one inch, thread diameter of shank is 7/32 with 40 thread. or 218-40, which fits all standard peep disk holes except Marble, but which does fit the Marble-Goss Diameter of object lens is 8mm and that of ocular lens is 4mm. Width of field varies according to distance which 'scope is mounted from eye. Based on a 100-yard range, with 'scope four inches from eye, field is about 12 feet, increasing until, with 'scope two inches from eye, field is about 25 feet C. B Mitchell, of Mohawk Products, tells us that every lens is rigidly tested and that with normal eyes, or fairly well corrected eyes, and with scope set at full magnification on distant object, newsprint can be easily road at 24 inches with same focus "This," he says, "means the front sight shows up very clearly, while distant objects are twice as plain as with the unaided eye.

W. R. Waavas Company, makers of scope sights for target and huntung rifles, as well as that Weaver IX shotgun 'scope of benefit to so many scattering shooters, announces their new Weaver-Choke, developed to (1) climnate 'blown' patterns; (2) reduce recoil, (3) adapt one gun to 20 to 70 duce recoil, (3) adapt one gun to 20 to 70 duce recoil, 3) adapt one gun to 20 to 70 duce recoil, and and divert through numerous vents gases which are released before shot leaves gun muzile, thereby reducing pressure on abot column and minimizing pressure on abot column and minimizing turbanes to shot, which, directed by the choke, continues forward, resulting in even and uniform patterns. Reduction of recoil is also secomplished through beffie rings and gas vents. High velocity powder gasce strike beffies, giving forward thrust, which reduces recoil.

Weaver-Choke is made of strong aluminum alloy, weighs no more than section of barrel removed, won't change handling or balance of gun, 18 finished with special process which gives bore a diamond-like

A group of Weaver-Chokes Tallest one is full choke in baffle tube



hardness and perfect surface for passage of shot. The six chokes, which may be changed in a few seconds, were designed as to length, shape, taper, constriction after exhaustive tests for following individual purposes.

Extra Full Choke--extremely close patterns averaging 85 percent for long range shooting, even to ducks at 70 yards, if shooter does his part Full Choke shoots about 75 percent, or same as standard, full-choke gun For ducks to 60 yards, long shots at doves, desert quail to 50 vards % Chokesmall game at 40 to possible 45 yards. For ducks from blind, western quail, Bobwhite, rabbits 1/2 Choke-fairly wide shot spread: dependable small game killing to 35 yards Bobwhite, rabbits, doves, and all shooting where range is not extreme. 4 Chokewide pattern for wooded, brushy country where shooting is fast, close, and range not over 30 yards. Skeet or scatter-designed expressly for skeet with wide, even pattern and full coverage on 30-inch circle at 20 vards. For single ball or slug loads.

Weaver Choke is now ready in 12 gage, available in other gages in July, is adaptable to all autoloading, pump, and single barrel shotguns, either plain or ribbed, can be attached by any good gunsmith or at Weaver factory.

NOPE POINTER COMPANY offers new 1½pound aluminum alloy folding tripod, with mackine paris of steel and brass, guaranteed to support 75 pounds. Scope remains attached to cradle, which is fastened to tripod by large, single thumbscrew, may be instantly set to any angle of offer; is controlled rability, accurately at ground level



Scope pointer triped, showing the cradle that nolds the scope, and rear leg with controls

by two revolving druna, integral with rear leg of tripod. Rotation of upper drun directs horizontal adjustment, while lower form wings, scope vertically. Legs are adjustable to any angle, have 12-inch spread at ground level, allow more clow room in prone position. Compactness when folded, controls, adaptability to any type optical equipment are additional appenia.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D. New York Bar

AFFIRMATION

THE decision establishing a radically new THE decision establishing a reasonar, principle for computing profits in suits for copyright infringement discussed on this page under the heading of "Apportionment" in the January, 1940, issue of Scientific American has been affirmed by the United States Supreme Court In affirming the decision the Supreme Court held that in computing an award of profits against an in fringer of a copyright there may be an apportionment so as to give to the owner of the copyright only that part of the profits found to be attributable to the use of the copyrighted material

The copyright statute provides that an infringer of a copyright shall be liable to pay to the copyright proprietor such dam ages as the copyright proprietor may have suffered or "all the profits which the infringer shall have made from such infringe-Prior to the present decision the courts have generally construed this provi-sion of the law as entitling the copyright proprietor to recover from the infringer all of the profits resulting from the sale or production of an infringing work even though some of the profits might properly be attributable to factors other than copyright infringement

In the present case the Court found that a motion picture produced by the defendant infringed a copyrighted play owned by the plaintiff The total profits realized by the infringer were found to be a little more than half a million dollars. The infringer introduced the testimony of experts showing that the plot and story contributed in but a small measure to the production and success of the motion picture. The experts testified that the main factors in producing the large profits were the popular actors, the artistic scenery, and the expert producers and directors. This testimony was apparently not rebutted by the copyright proprietor and accordingly was accepted by the Court as indicating the approximate contributions made to the success of the moving picture by the copyrighted material on the one hand and by the infringer on the other hand. As a result the Court awarded only 25 percent of the total profits realized by the infringer to the copyright proprietor

In reaching its decision the Supreme Court pointed out that it had been the cus tom for many years in patent infringement suits to apportion the profits in accordance with the approximate proportions resulting from the infringement and from extraneous contributions made by the infringer. The court concluded that there was no reason why the same principle should not also be applied to suits ios right. The section of the copyright law providdied to suits for infringement of a copy-

ing that the infringer shall be liable to pay "all the profits which the infringer shall have made from such infringement" was held to mean that only the profits resulting from the use of the infringing material shall be paid to the proprietor and that profits resulting from extraneous matters were not payable to the copyright proprietor. The Court held that "when such an apportion ment has been fairly made, the copyright proprietor receives all the profits which have been gained through the use of the infringing material and that is all that the statute authorizes and equity sanctions

FTC IN IUNCTION

THE Federal Trade Commission for many years has had power to restrain unfair methods of competition in commerce More recently, the Commission has been given power to restrain unfair or deceptive acts or practices in commerce. In the usual proceedings the Commission issues a complaint against a party who is charged with using unfair methods of competition or unfair or deceptive acts or practices If, after testimony has been taken, the Commission finds that the party is guilty. it issues an order requiring him to cease and desist the unfair or deceptive acts or practices

Naturally, considerable time must clapse between the serving of the complaint and issuance of the order to cease and desist because the party complained of must be given an opportunity to file an answer, tetimony must be taken, and due considera tion must be given to the testimony. In the meantime the party may continue the practices complained of In certain instances the continuance of the act com plained of prior to the issuance of the order will be extremely detrimental to the public interest and under an amendment to the Federal Trade Commission Act the Com mission has been given power to apply to a Federal Court for an injunction to restrain

the wrongful act The ammendment to the law provides that where it appears that it would be in the interest of the public, the Commission, pending the issuance of a Complaint, may apply to a district court of the United States to enjoin the dissemination of any false advertisement and that upon a proper showing a temporary injunction shall be granted without a bond. This is an extraordinary remedy since the party is restrained from committing the acts complained of prior to an ad cation of the issues by the Federal Trade Commission. Naturally it is only resorted to under unusual circumstances where the public interest is involved.

An example of a proceeding under this section of the law is found in a recent case

in which an injunction was granted to restrain false advertising in the sale of cosmetics through a puzzle promotional scheme It was charged by the Commission that a company selling cosmetics initiated its sales by means of a puzzle contest for which a prize of \$50 would be paid for a success ful solution. When a contestant sent in a solution it was alleged by the commission that he was notified that his entry had passed a preliminary check-up and was before the final judges If a payment of \$3 was submitted by the contestant he was advised that he would receive five dollars worth of cosmetics and if a so called "promptness prize blank" was returned within a designated time there would be a chance to win a cash prize in the amount of \$1250 and an automobile

The Commission charged that the entire plan was devised for the purpose of selling cosmetics which were of inferior quality for which the purchaser would have no use and which could not be resold without loss The Commission also charged that the de fendant corporation was a reincarnation of a former corporation which promoted the identical sort of sales scheme and which had dissolved in a short time to be succeeded by another corporation, all for the purpose of avoiding the provisions of the federal laws and evading the Federal Trade Commission Under the circumstances the Commission argued that to protect the pubhe interest it was necessary to enjoin the company at once, prior to the issuance of a complaint The Court sustained the con tention of the Commission and restrained the company from circulating the advertising relating to the sale of cosmetics through a puzzle promotional scheme

EMANCIPATION

SUIT charging unfair competition was A SUIT charging uniair competition and brought by the author of an outstanding play dealing with the life of Abraham Lincoln against the producer of a movingpicture drama also based on the life of Abraham Lincoln

The suit in question was unusual in that it did not charge plagiarism or copyright infringement but was based solely on the theory that the author had dispelled the public apathy with regard to the life of Abraham Lincoln and had caused a recrudes cense of lively interest in his life and under the circumstances the moving-picture producer should not profit by this renewal of public interest, especially since the producer had previously expressed the belief that the American public had lost interest in Lincoln

The Court pointed out that historical facts such as the facts dealing with the life of Lincoln were in the public domain and were available to anyone Since anyone had the right to use and refer to these facts the Court concluded that the production of a motionpicture play based upon the story of Abraham Lincoln's life did not constitute unfair competition

In reaching its decision the court made the following statement

"Countless decisions defining unfair competition preclude any favorable considera non for plaintiff's claim. Since the source of their material belongs to public domain. no exclusive right to the use thereof can be acquired even though they were the first to discover its value as a medium to awaken public interest "

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SCIENTIFIC AMERICAN

NINETY-SIXTH YEAR

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ATICHST . 1940

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Essential to defense against enemy aircraft are "listening posts" of the type shown on our front cover Set up on mobile trailer units, these ears of the Army are completely any direction to catch the faint hum of aircraft long before they come into visible range Data thus obtained are relayed to anti-aircraft batteries -Photo by Robert Yarnall Richie

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Current Bulletin Briefs

IN NEW DRESS

I'm this issue, Scientific American opens a new period in its 86 years of publication Starting with a new cover design and modern, easier-to-read typography, we have evolved a new policy of editorial treatment that, we feel sure, will make Scientific American even more valuable to its readers than it has been in the past.

By segregating all editorial material into specific classifications, we are able to present a departmentalized magazine that permits the reader to turn immediately to those sections that hold the greatest intereste to him and to find there the cream of the pertinent news Then, at lessure, he can survey the other sections, knowing that under certain headings he will find specific twees of information.

Preview "dummles" of the new Scientific American, sent to hundreds of readers, have been enthusiastically received We hope that you will be equally pleased with the final and complete result. In any event, the edutors will appreciate your expression of opinion, whether it be in the form of a bouquet or a brick-bat —O D. M.

ANTI-SAROTAGE

UPPERMOST in the thoughts of millions these days is the current problem of building up our national defenses Yet in all the billions of words that have been printed on the subject recently, little or no mention has been made of what should be our first and most determined step. Too much emphasis cannot be put on the need for an Intelligence Service expanded to the point of superiority, in numbers and brains, over that of any possible future enemy

We are a heterogeneous nation. Walking the streets past each of us every day are aliens, first generation descendants of aliens, and misguided "old Americans" who live under various delusions. This is not to say that these categories are all inimical to our interests. They aren't, some, indeed, even among the aliens, are better Americans than some sons of ploneers. But the numbers of these and the freedom of speech permitted them in our democracy make it difficult to identify them until after they may have done their mischief And it must be remembered that "whispering campaigns" of propaganda can be a more serious form of sabotage than destruction of a powder factory or a power plant. Such campaigns have already started in some sections of the country.

Insidious work of foreign agents, with the connivance of residents, is going on under our noses constantly Nevertheless, we want no vigilantes, no civilian rumor-mongering or tattling on our neighbors It follows, then, that a vastly superior Intelligence Service should be organized and carefully trained. If this is not done, our national defense program will assuredly suffer all along the line from the work of numerous foreign agents now present in the United States—F D. M.

A DRY-DOCK NEEDED

A NUMBER of things stand out in much of the current talk concerning the need for adequate national defense. One is the fact that we are now building battleships having a tonnage of 45,000 and may eventually



go to larger sizes. Another is the fact that New York City, because of its importance as a possible fleet base in time of war, and its excellent transportation facilities, should be equipped in every possible way to render it strategically efficient in case of war.

The shocking truth is that nowhere in the New York area is there a dry-dock capable of caring for our new 45,000-ton battleships. There is none which could take care of our two largest aircraft carriers, the Saratoga and Lexington Yet in time of war these sharatoga and Lexington Yet in time of war these sharatoga be damaged near New York while defending the port. They could not then put in at New York or be towed in for the necessary repairs before going into service again. The New York Navy Yard dry-dock cannot take care of these ships, is 35 years, old, and is up the East River behind bridges which might be bombed so as to block the exit completely Indeed, in time of war, continued operation of this Yard much hang precariously in the balance.

The Port of New York Authority has recently urged the construction of a dry-dock of a size that would take not only our naval vessels but also the larger transatlante liners Such a dock might be constructed at Jersey City, Wechawken, Bayonne, or Brooklyn, but certainly should not be up the East River into which bridges might fall after being bombed. To us, a project of this sort seems a vital part of our national defense program. If that program is to be rounded out, the repair facilities afforded by adequate drydocks in strategic positions are as necessary as the warships which will defend our shores. The service of the fleet will be handicapped if such facilities are not prepared for their use.—H. T. R.

HAVE SOME FUN

A PLAYGROUND exclusively for adults has met with great success in a recreational center near New York City. Here is equipment designed after that formerly used for children, but scaled up to meet the demands of grown-ups

And why shouldn't mature people hop around on pogo stucks, enjoy the thrills of a see-saw, experience the forgotten joys of a sliding board, pump on swings to their hearts' content, all in the privacy of their own playground and free from the prying eyes and competition of youngsters? Psychologists tell us that the way to keep young is to do young things, to forget the cares and worries of workaday life, to be kids again. The flexible minds that conceived the playground referred to have done their share to make this possible in one small part of the world Other municipalities will do well to copy.—A P P

50 Years Ago in . . .



(Condensed From Issues of August, 1890)

DEFENSE—"The exposed and comparatively defenseless condition of our most important seaboard cities, in respect to foreign naval attack, has for years been the subject for talk in Congress, but up to the present time little of a practical nature has been done in the line of protection it is true a few vessels of war have been ordered and some preliminary steps taken toward the manufacture of heavy guns for fortifications. But in regard to the systematic and permanent defense and safety of such important harbors and cities as Portland, Boston, New York, we believe no definite plan has been fixed upon, no material steps as yet taken?

TUNNELING—"A tunnel to extend between Port Huron, Mich, on the American side, and Sarnia, on the Canadian side of the River St Clair is being bored by means of the Beach hydraulic shields. The walls of the tunnel are constructed of cast iron segments, thirteen of which and a key form the circle. The shield is the



invention of Mr. Alfred E. Beach, of the Scientific American. It consists of a strong cylinder somewhat resembling a huge barrel with both heads removed. The front end of the cylinder is sharpened, so as to have a cutting edge to enter the earth. By means of a system of hydraulic jacks, capable of either combined or separate action, it is possible to govern the direction of the tunneling shield with the utmost precision, making it to ascend or descend in the earth, according to grade required, or travel on a curve of any desired radius. In the St. Clair tunnel work, each shield is circular, 21 feet 7 inches in diameter, 16 feet long, and is built of plate steel one most hick."

GOLD TEETH—"American dentists insert in American tech each year, the enormous amount of 800 kilogrammes (about 1,800 pounds) of the precious metal, which represents nearly \$450,000 If appears that in less than one hundred years the American cemeteries will contain a larger amount of gold than now exists, in Finnee"

DEEP—"It has hitherto been upposed that the maximum depth of the Mediterranean was 10,785 feet, between Sicily and Sardinia Lieutenant Magnachi, of Italy, has found a depth of 13,550 feet, between Malta and Candia"

MILEAGE—"The following is given mileage at the beginning of 1889 Europe, 133,900; America, 190,000, Asia, 17,800, Africa, 5,200, Australia, 10,500, total, 357,400, as compared with 293,000 in 1884"

INDUSTRY MOVES—"The transfer of industries is one of the most strongly marked and distinctive features in modern industrial life. Its economic causes are to be found in the exhaustion of local supplies, the development of new areas, and the changing centers of commercial distribution. The deportation of manufactures from the Bastern States to the West and South will largely change the old centers of wealth and industry. These displacements may entail some local misfortune, and break up some time-hoored establishments, but in a general and national sense the distribution of industries is an economic necessity and an industrial blessing."

TRAVEL HAZARDS—'Travelers on the Eastern Bengal Railway have placed before their eyes on entering the stations of the road a placerd containing the following cheerfu information. Passes of the placerd containing the following cheerfu information. Takes of the road of the place of the road of the place o

SPEED—"In a recent lecture before a scientific club, Professor Elihu Thomson declared that much higher speeds than can now be obtained with steam locomotives are to be expected by means of electricity, and be considered from 100 to even 150 miles an hour possible. While in the steam locomotive there are reciprocating parts that must be put in motion, stopped, and reversed continually, in the electric locomotive we have simply a rotary motion, which makes it possible to run with economy at much higher rates of speed."

WORDS— Eighteen words have come into the language — probably temporarily, most of them—be denote the act or state of electric killing. They are as follows: Electromort, thanelectrize, thanatelectrize, though electroic prophon, electroise, electrootop, electropophony, electrootony, electrootopy, electrootopy, electrootopy, electrootopy, electrootopense, electrootop, electrootopense, electr

RABBITS-"A recent report by the United States consul at Sydney, N S W, gives a vivid idea of the extent of the [wild] rabbit pest in Australia The extraordinary fecundity of the animals under the climatic conditions have caused the country to be completely overrun regions are devastated, and the grass and other herbage is devoured The figure of five millions is given as the possible increase of two pairs of rabbits in three years Yet even this is a low estimate of the possibilities average life of a rabbit is put at about nine years. The doe may have young eight times in a year, averaging eight each time The first litter is produced when but four months old The progressions based on these figures lead to astonishing results"

ELECTRIC HEAT—"Electrically heated flat irons are now made which are very serviceable. The flat iron is of the usual form, but made hollow. The interior contains a lot of coiled wires, through which the electrical current passes and heats the wires hot. The latter are arranged between protecting sheets of mice and asbestos. You turn a switch, and the flat iron at once heats up ready for use."



The Voice with a Smile

"We hold," says a well-known writer, "that the young ladies of the American long distance telephone wires make up what is probably the most efficient public service crew in the world. They have profound patience and that capacity for taking pains that some one once said is all that genus amounts to.

"We once called a fellow at a hotel in Philadelphia but he had just departed on an automobile trip in a westerly direction. A few days later the long distance operator caught up with him in a little town in Missouri and he was the most surprised man in all but one of the States of the Union. The exception was New York. We were the most surprised there. To this day we have no idea how the operator did it."

DAMON RUNYON in the New York Mirror

BELL TELEPHONE SYSTEM

The Bell System cordially invites you to visit its exhibits at the New York World's Fair and the Golden Gate International Exposition, San Francisco.



AUGUST 1940 · SCIENTIFIC AMERICAN



STEEL CAVALRY OF MODERN WAR

A change of such modern tank cavalry, though a far less inspiring spectacle than a charge of regular cavalry, has a greater influence on the morale of the attacked in time, however, the psychological effect is lessened, though their greater "manpower," or striking power per man, is permanent Judging from present events in Europe, development of the inevitable successful counter to highly mechanized forces is still in the rather distant future. Whether this counter will be some new weapon or simply a sufficient number of opposing tanks, it is too early to say. However, if probably will be found in time.

MACHINES FOR WAL-

Organization and Operation of Mechanized Forces of Our Army

CAPTAIN J. E. McINERNEY

ECHANIZATION, as it refers to war, may be truly defined as the adaptation of the bestknown mechanical developments of the existing times to the weapons of war In recent years, the term has been restricted to the use of automotive vehicles for combat purposes This article will deal with this conception of the term. and will not touch on the subject of motorization which relates to the vehicles of the army that are adopted for general purposes, such as hauling cargo, ammunition, personnel, and equipment, and for towing guns, trailers, and other wheeled equipment

The development of combatt whether carrying armament and providing protection for the crew has been a gradual one throughout the ages History is full of attempts to design devices to permit the soldier to approach the enemy under protection at a reasonably rapid rate and with all the fire-power possible

Naturally, the greatest advances were made in this type of equipment during the first World War The conditions of the war in 1916 -that is the use of the machine gun in conjunction with the trench and barbed-wire systems for defense-had so extensively increased the casualties of an attacking force that the war developed into a stalemate It was impossible to take the offensive without an enormous force and without considerable artillery preparation which eliminated the essentials of the success of the offensive-the elements of surprise and maneuver. The employment of sufficient forces and their necessary equipment to conduct a successful offensive resulted in completely blocking most of the roads in any given sector to the extent of eliminating all freedom of maneuver.

It was soon discovered by the nations involved in the first World War that their resources of manpower were giving out faster than their munitions. To increase their

MILITARY SCIENCE

fire-power and to conserve their supply of men became the goal It was realized that, with the conditions of the terrain as they existed after two years of war, a wheeled vehicle could not develop the required tactical mobility Two commercial inventions greatly assisted in solving the problem a tracklaving device and the internalcombustion engine The tracklaving device was first adapted to a combat vehicle, called a tank, in England in 1916 The name "tank" was used to keep the development as secret as possible With the development of the tank, armed and armored, the offensive was again restored, giving the attacker mobility, protection, and fire-nower

We can get some idea of what our World War leaders thought of the effectiveness of mechanized units from the numbers of tanks which were on order in 1918 for the projected offensives of 1919 3 ton (Ford) 15,015

3 ton (Ford) 15,015 6 ton 4,440 Mark I 1,000 Mark VIII (Anglo-US) 1,500 Mark VIII US 1,450

Total 23,405 For our nation, mechanization has many distinct advantages As the most highly industrialized nation in the world it will give us, as a result of our great production facilities, a superiority which cannot be approached by the nonindustrial nations An army which is mechanized will have on its side the necessary elements of surprise, maneuver, mobility, and firepower, which are required for a quick and decisive victory. A nation not mechanized will have to fight a losing war or a long, costly, and inconclusive one with the resulting human, industrial, economic, and moral attrition.

It has been natural for us to follow, in a general way, foreign practices concerning the use and development of our mechanized units However, our geographical and economic conditions are such as to dictate characteristics for our army which might be entirely different from those of most other armies For example, the military tactics of a given country may have been dominated by the condition of its being hemmed in on all sides by potential enemies, requiring that they have fast mobile units which can be concentrated at any of its many frontiers on short notice These conditions, therefore, might lead to the neglected development of extra-heavy tanks, and tend toward the adoption of light, fastmoving vehicles

MOTHER country, on the other hand, feels that her prime and foremost objective is to prevent an enemy from getting a foothold within her borders Hers is mainly a defensive attitude, and this is reflected in the type of vehicles which are developed for their mechanized units; that is, a medium tank, heavily armored, of relatively low speeds and no great cruising ranges. This type is not as vulner-

This article is released for publication by the Chief of Ordnance, U S Army Statements and opinions are to be understood as individual expressions of their author, and not those of the Ordnance Department able to anti-tank weapons as the

Our problem is more nearly similar to that of a nation having extensive colonies requiring types of light, armored cars which have great cruising ranges and can be used not only in actual combat in a major war, but also in settling domestic troubles throughout the entire domain. When we consider that the theater of operations of the American army might cover the entire American continent it should be realized that our chief requirements are for light, highspeed, long-range, cruising vehicles

Although many foreign nations. were active in developing mechanized units immediately after the war, very little was done in this country until 1925 It is true that we did maintain a number of light and heavy tank organizations equipped with the slow-speed. wartime vehicles These units were mechanized infantry. In 1925, a board of officers was convened in the War Department, and as a result of its study an experimental mechanized force was assembled at Fort George G Meade, Maryland. in the summer of 1928 Included in the equipment of this force were four light (71/2 ton) tanks capable of a speed of 20 miles an hour, two cargo carriers with the same chassis as the light tanks, and two light and four medium, armored cars Most of the other equipment had been procured during or after the World War

The results obtained with this experimental force were so encouraging that, in 1930, Congless appropriated funds to organize an actual mechanized force at Fort Eustis, Virginia This force totaled 640 men, and included therein were representatives from every branch of the service

In 1931, the War Department assigned a mechanized mission to the cavalry and directed that the mechanized force at Fort Eustis be demobilized and formed into a reinforced cavalry regiment. This was no order to permit the cavalry to develop its organization and equipment for the performance of its normal cavalry missions. Thus was born the mechanized cavalry.

There is a definite need for two distinct types of mechanized forces. The first should be highly mobile and capable of rapid advances so as to pass through enemy columns and to make flank or rear attacks



An American medium tank. It is fast, well armed, and has good armor

These forces must be able to penetrate through thinly defended areas, or exploit a break-through made by the heavier fighting forces of infantry supported by infantry tanks, but cannot, because of their equipment, be required to deal with heavily defended positions. The second type should be equipped in such a way as to break through heavily defended areas. The first missions will be performed by the mechanized cavalry, and the second by the mechanized infantry.

The War Department Directive of 1931 prescribed the mission of the mechanized cavalry as follows "Mechanized cavalry will be organized to fulfill the normal cavalry role, substituting the vehicle for the horse" This then requires that mechanized cavalry perform the following normal cavalry missions. Offensive combat, long distance strategic reconnaissance. fighting for the theater of reconnaissance, seizing points of strategic importance, tactical reconnaissance, pursuit, delay of hostile advances, exploitation and taking advantage of break or weakened positions in hostile battle line, and attacking enemy rear installations

This War Department Directive did not in any way envision the complete elimination of horse regiments from our cavalry organization. There are still many conditions, especially in the western hemisphere, under which the cavalry mission can be better accomplished by horse troops than by mechanized units.

As a result of this Directive, the Seventh Cavalry Brigade Mechanized was developed at Fort Knox. It is composed of the following units 2 regiments of cavalry mechanized, 1 regiment of artillery, 1 brigade headquarters troop, 1 ordnance maintenance company, 1 quartermaster maintenance company, 1 squadron of observation aviation, 1 medical troop, and 1 engineers troop

It is planned to increase the mobility of the brigade by adding a reconnaissance and support squadron composed of a reconnaissance troop, machine gun troop, and a motorcycle troop. In addition to acting as a brigade reconnaissance unit, this squadron will also serve as a minor reserve and a small arms, fire-support unit

In order to increase the fire power of the mechanized regiment, a third combat car squadron will be added to each regiment. This will increase the number of combat cars in the brigade from 112 to 172

The cavalry regiment is the smallest organization with the equipment and means necessary to perform the four principal cavalry missions, namely

- a The reconnaissance troop mounted in scout cars equipped with caliber 50 and caliber 30 machine guns is charged with carrying out the necessary reconnaissance mission
- b The combat car squadron mounted in combat cars with caliber .50 and caliber .30 machine guns and with ample armor plate for protection are capable of exerting vigorous striking blows
- c Small arms support is furnished by machine gun troops



This light tank represents great improvement over its World War prototype

in scout cars

d A mortar platoon, mounted in vehicles somewhat similar to scout cars, firing smoke shells, provides for the defense against hostile anti-tank weapons

It is interesting to note that our largest mechanized unit is a brigade Most of the large foreign nations have complete mechanized divisions. The Germans have the panzer division, the French, a light mechanized division, and the British, armored divisions.

The mechanized cavalry will have their greatest opportunity of using their organizations to best advantage in open warfare. However, in cases where the enemy has been able to establish himself temporarily in a strong defensive position, it will be necessary to under the mechanized units capable of exerting greater shock than the highly mobile cavalry units. This shock action will be delivered by the mechanized infantry.

The infantry is charged with the principal mission in battle and is essentially the arm of close combat and can, through the employment of its own weapons, act independently of other arms

In order for the infantry to carry out its mission, it is furnished with tanks which are equipped with the proper armor, armament, and mobility As a general rule, tanks will function in close co-operation and co-ordination with the foot soldiers, either by proceeding or accompanying the assaulting echelons. When operating directly in front of the attacking infantry, tanks are closely followed by the foot soldiers. The visibility from

tanks is naturally not the best, and defenders in many cases may be passed over by the attacking tanks. Under the protection of the advancing tanks, the infantry can properly clean up the advance areas and then permit the tanks to penetrate into the rear areas

However, there will be cases when the defense is so thoroughly organized and equipped with antitank weapons that it will be necessary for a wave of heavy, armored and armed, relatively slow-speed tanks to precede the lighter and more mobile tanks. The former tanks are referred to as leading tanks, whereas the lighter tanks are classed as accompanying tanks Leading tanks may operate in support of infantry regiments, or they may be attached to the regiment When operating entirely within a regimental zone it is preferable to have leading tanks attached to the regiment

Accompanying tanks are assigned to divisions and then may be attached separately to different units as small as a battalin Our tank organizations are made up of tank regiments and separate divisional tank companies Practically all the divisional companies are part of National Guard organizations, whereas the Regular Army units are tank regiments.

Light and medium tank regiments are practically the same in organization, with the latter having a slightly greater number of personnel Both are composed of three battalions of three companies each, and the company in turn consists of three platoons This represents the triangular type organization. Within each regiment there are 162 tanks, of which 135 are combat tanks, and 27 are command and staff tanks

It is interesting to note that since the war started the French regimental tank organization has disappeared and the tank battalian is now the tactical and administrative unit Outside of the mechanized division, tank battalions are assigned to GHQ Reserve or to the Army

As the first requirement in allocating tanks is to furnsh sufficient support to overcome any resistance that might be encountered and still have sufficient reserve strength to push on to further objectives, tanks should be used in relatively large numbers The tank company may operate separately, but the tank platoon never does

In deciding on the use of tanks. it is essential to give careful consideration to the nature of the terrain. In making a study of this problem, all possible information should be obtained from maps. aerial photographs, and by ground and air reconnaissance Natural obstacles to tanks are rivers and streams which cannot be forded, marshes, fordable streams with steep banks, thickly wooded areas with large trees, and areas with closely spaced boulders In open, rolling country, where excellent fields of fire are available to the defenders, the effectiveness of tanks is greatly limited

Some idea of the importance of proper reconnaissance may be obtained from the recommendation of Major General Walter C Short, Commanding General of the Fourth Corps Area in discussing the lessons learned from the Corps exercises at Fort Benning That recommendation was that a troop of mechanized cavalry be added to each of the streamlined divisions, the troop to have three platoons-one to be assigned to each of the combat teams of artillery and infantry for reconnaissance purposes

In addition to a study of the terran to determine the natural obstacles, it is essential that careful measures be taken to determine what obstacles have been set up by the defenders Anti-tank weapons will be numerous in any case where the defenders have a day or two to become organized Whether the guns will always be of the caliber to defeat the armor of the tanks might be questioned As the armor plate of tanks gets heavier, there

MILITARY SCIENCE -

will be a requirement for weapons of greater muzzle velocity maintaining the same mobility for the gun, or less mobile guns of larger caliber. The race between armor plate and the gun has been going on for years. In naval history it is believed that the gun has been going on for sears. In naval history it is different factors that influence the results that we may expect a different answer.

The following extract from an article by Major O F. Marston in the January-February issue of Field Artillery Journal may be of interest In speaking about antitank defense he remarked "What results have been accomplished? At least the field artillery feels that, where indirect laying is used, covering zones and areas where zone fire is used on assembled tanks or other mechanized vehicles, the problem has been solved However, where direct laving is employed. even the most optimistic are not agreed that a solution has been found: and the faster the tank moves the fewer there are who are in agreement on a solution to this vital problem After talking with many officers and men, and after having had considerable experience with the problem for several years, and with the latest equipment now in the hands of our troops, the writer is of the opinion

that the problem is far from solu-

There is no commercial demand for the types of vehicles which are required by our combat arms. The requirements of high speed for strategic mobility and for crosscountry tactical mobility are such as to require specially designed vehicles In designing these specialpurpose vehicles, it is the policy of the Ordnance Department to use, as much as possible, commercially available units, such as engines. transmissions, and the like. In most of our combat vehicles, the weight and space factors of the power train units are of paramount importance. As much as possible of the total weight of the vehicle should be devoted to armor plate Also, sufficient space must be provided in the fighting compartment for the efficient servicing of wea pons, for the comfort and convenience of the crew, and for carrying ammunition, guns, radios, and other impedimenta

The lighter, high-speed, full track-laying vehicle used in our service is over ten tons. In order to get the required performance in our combat vehicles, it is necessary to have a power/weight ratio of not less than 25 horsepower per ton weight of vehicle. Commercially available engines in the automo

tive industry are not made with horsepower greater than about 185. Rather than design a special engine, which is an exceedingly long and expensive undertaking, the Ordnance Department has adopted commercially available engines from other fields for use in most of our combat vehicles.

Knowing the many advantages of the Diesel engine, such as reduced fire hazard, increased cruising range, absence of radio interference, and so forth, the Ordnance Department has not neglected the development of this type of engine A number of Diesel engines giving the required performance for our combat vehicles have been procured This type of engine is particularly well adapted for use in cavalry combat vehicles because of the increased cruising range—is almost double that of gasoline engine vehicles of approximately the same weight

Of the full track-laying type of combat vehicles, our army is equipped with combat cars. light tanks and medium tanks We have experimented with convertible, or two-purpose, types of tanks and combat cars. The convertible type of vehicle is popularly known as the Christie type, named after Mr. J. W. Christie, an inventor who sold a number of experimental vehicles to the War Department.



Ready for action in Army maneuvers; tanks and scout and combat cars of 13th Cavalry Mechanised





In modern warfare, tanks and planes operate in co-ordination

From an engineering point of view, it is almost axiomatic that a convertible vehicle will weigh more than a single-purpose machine of the same performance and characteristics. It may be noted that none of the major powers except Russia have produced convertible tanks.

The light tank used by the infantry and the combat car with which the mechanized cavalry are equipped are similar in many respects The engine, power transmission system (except the ratio of the final drive), the cooling system, steering and control systems, fuel and oil systems, and the electrical system are common to both The chief difference is the thickness of the armor and the amount of armament The combat car used by the cavalry has a requirement for a higher speed and less armor than the tank.

Tanks in the weight class above 12 tons and less than about 35 tons are considered medium tanks. The medium tanks used by our service have ranged in weight from about 15 tons to 20 tons. The French army is equipped with a number of medium tanks of about 35 tons in which are installed 75mm cannon.

Our army has not been furnished any heavy tanks since the World War when the Mark VIII tank, weighing about 40 tons, was developed.

In addition to the full tracklaying type of vehicle, there is a demand for half-track and wheeled vehicles The half-track trucks and cars are part of the equipment of the mechanized cavality and are used by the artillery attached to the mechanized unit as prime movers for light guns and for hauling ammunition. The wheeled vehicles are scout cars, also used by the mechanized cavality, for machine gun and reconnaissance troops. The scout cars are four-wheeldrive vehicles equipped with armor and armament and have fairly good cross-country mobility and are capable of speeds on main roads of over 50 miles per hour

The recent events in the present war have clearly indicated that the old axiom, "Getting there fustest with the mostest men" still applies, but the tempo of all warfare has been greatly accelerated However, it has also been shown that, "He that has mostest (mechanized vehicles) fustest will get there fastiest." The machine has not entirely replaced the man in modern war, but a nation that is not industrially prepared for war is doomed to an uncertain fate, to say the least!

TANKS

United States Deficient

in Combat Vehicles

THE present war in Europe has shown the military effectiveness of large numbers of combat vehicles of several types, but the United States is saddy deficient in this arm of the service. In recent hearings

before the Senate Committee on Appropriations, the following figures were given to show the strength of our mechanized forces

Will be on hand
On hand upon completion
May 1, 1840 of program
at tanks, M2A4 15 174
ium tanks M2 18 194
it cars 485 1346
bbt cars

These figures consider only the very latest models We do have several hundred light tanks of earlier design but it is believed that these would have very little use except in training.

LARGER CRUISERS

New Type, Heavily Armed and Armored, Suggested

T TAKES from three to five years, depending on urgency, to build one battleship in an American yard. In times of national peril, more effort is expended on construction of a larger number of small warships.

Under construction and planned for the United States Fleet at present are 10 battleships Only two of these, however-the Washington and the North Carolina-have been launched, and each of these two will require more than a year to finish Completion of the others is proportionately far in the future Due to this situation, coupled with the war in Europe, it has been suggested that the United States huld for the Atlant'c a number of large cruisers of 20,000 to 28,000 tons This would be an entirely new type of warship-fast, armed with 11inch guns, and well armored against air bombs. It is believed that these ships will constitute a more efficient type for operation in coastal waters than our battleships but will be far more powerful than any present cruisers or the oversized, fast destrovers which may be built to support them

Whether these new ships will be of the size indicated above or something smaller, Chairman Vinson of the House Naval Committee declares that their construction will not disturb the present building program

Incidentally, that program probaby will be greatly enlarged in the near future, perhaps before this issue is published As we go to press. Congress is considering a plan to increase our Navy by 70 percent, giving us, by great odds, the most powerful navy in the world. If details are made available, we will publish then later

Achievements in Textiles

Commonplace Fabrics with Superior Characteristics Given by Special Treatments

PHILIP H. SMITH

HEN it becomes possible to remove shoe polish, inks, fruit junes, and coetkails from delicate silks and cottons by merely dunking them in a glass of water, you've got something. When a fabric so treated is immediately spot free and dry, you have, to be exact, a marvel of chemistry, not to mention a boon to housewives.

Brilliant achievement in the improvement of commonplace textiles has been all but obscured by the more sensational creation of synthetic fibers out of air, coal, and water, or from cow's milk But there are now on the market cottons, rayons, and silks which repel water and resist spotting. There are fabrics which resist creasing to maintain their freshness for a long period of time, and there are woolens which won't shrink and are distasteful to moths. If fireretardent finishes are desired on textiles, they can be had, and so can finishes which are unaffected by mildew, a serious problem at all times but especially so in damp climates

The threat of synthetic competition can hardly be credited with all the progress in textile finishes Research has been seeking a way to impart these several desirable properties for many years and success is the logical fruit of cumulative effort.

The public is beginning to learn of water-repellency but there is still confusion in some minds as to the difference between repellency and water-proofing They are quite unlike. The former describes a treatment whereby fibers are rendered proof to water while the fabric remains porous, the latter calls for making the entire fabric surface impervious to water Water-proofing is a much older art.

There are two common ways to obtain a water-repellent finish One is to use a soap bath followed by alum or an aluminum salt to

deposit an aluminum soap on the fabric. The other is to apply an aluminum or lead soap from an organic solvent. There is a more recent process wherein a wax emulsion in water is applied to a fabric in a single bath. Those finishes were used first for outerwear garments, but varied applications have been made, realizing that repellency means freedom from water-spotting, because a water spot is nothing more than a local contraction of fibers which alters light reflection.

By applying water-repellent finsishes to hosiery they can be been made virtually splash-proof Dirt is made virtually splash-proof Dirt is prevented from penetrating the end dusting will remove it. Snag-proof finishes for hosiery are usually wax emulsions which tubricate the surface to resist abrasion, but the surface to resist abrasion into use and the surface to resist abrasion.

All of the foregoing processes leave smething to be desired because they are impermanent. It is true that they lengthen time between cleanings and so increase fabric life, and repellency can be restored by incorporating products in the cleaning process but this is troublesome. Today, permanency is a reality.

One manufacturer has developed a process which will survive about 10 cleanings and he does a mail-order business in reviving repellency for a nominal sum There is also a single chemical compound available which can be applied in four stepsimpregnation, drying, heating, and rinsing-to render cotton, rayon, and silk durably repellent and do almost as good a job with acetate rayons and wool fabrics The compound must be applied during the finishing process as it requires good equipment, but it is not a resin as one might suppose

There is practically no limit to the application of this water-repellent product It is

now being applied to sport clothes, shower curtains, and outdoor furniture, often to replace waterproof materials Because it leaves fabrics porous, it serves very well to treat undergarments, and the fact that it makes pressing less imperative promises its wide use for men's suits. Hence it may have wide application

The synthetic resins have been seized upon by the textile industry and are being given quite a wide play One of the first applications to come to the attention of the consumer was the "fused" shirt collar which won't wilt This now widely used product is made by sandwiching cellulose acetate or other thermoplastic resin between layers of fabric. Resins also are used to prevent slippage of varn in woven materials so that garments won't lose their shape, to bind colored pigments in printed fabrics, and to give a glazed effect to textile surfaces

DIFFERENT types of resins are used to achieve special effects. Thus the methacrylate type can be used to give fabrics a "handle" which resists laundering and dry cleaning It is also employed as a yarn size for viscose and acetate warps and for filling yarns of crepe fabrics, because it is easily removed and does not encourage bacterial growth as do casein, glues, and gelatine Vinyl resins were the subject of a recent announcement to the effect that they serve excellently for water-proofing and moth-proofing with all kinds of fabrics, but this development is still young



Crisp organdy apron that is waterrepellent, permanently starchless

SCIENCE IN INDUSTRY -

Crease - resistance, or crushproofing as it is sometimes called. is a quality now imparted to cotton. rayon, and linen as an outcome of English experiments with ureaformaldehyde resins. Here the problem to solve was one of getting the resin inside the cellulosic material of the individual fibers, because an outside coating only produces a stiff and brittle cloth The process requires impregnation of the cloth in a bath of resin comnonents urea and formaldehyde with a catalyst, or a lightly condensed mixture, provided the condensation permits complete penetration The fabric is then passed through a mangle to remove all excess liquid, and dried. After drying, it is heated to a high temperature to bring about polymerization, or the creation of large molecules from small ones Then such chemicals as have not been



Satin becomes practical for sportswear when treated with water-repelling chemicals, as in this ski-jacket

rendered insoluble can be removed by washing

Urea-formaldehyde resins have the capacity to alter the life and draping qualities of fabrics, to increase the fastness to fugitive colors, and to reduce shrinkage in washing. Rayons treated with them are given greater strength, particularly in the wet state

The use of resuns by the textule industry is still in its infancy, but for that matter, the resin industry has yet to matture. With approximately 150 different resuns on the market and more being born by the minute, it requires much research to determine the benefits to be derived from any single one, or

to select the best Application of results of abrois increases their cost slightly and the textile industry is slightly and the textile industry is cloath to add to cloth prices until the public demands certain properties and is willing to pay for them. Furthermore, an industry as old and as highly specialized as the textile industry is slow to adopt the new, but there is enough stirring right now to promise a wide use of resinous products.

During the past two decades a great deal of research went into development of fire-retardent finishes, but, one and all, the product had some practical disadvantage. The latest and most satisfactory process seems to be one employing ammonium sulfamate It is claimed not to dust off, nor to alter the feel, appearance, and durability of fabrics. It will withstand ordinary dry cleaning, but not laundering Research to attack the problem.

of mildew and moths has been quite successful and both can mean the saving of millions of dollars resulting from cloth destruction The most satisfactory agent for mildew control has been found to be salicylanilide Customary practice is to impregnate the cloth with the chemical from an ammoniacal solution, and then dry it With the evaporation of the ammonia, the insoluble agent is left dispersed throughout the fibers and threads. Among the several chemicals developed for moth-proofing, the best appear to be organic and morganic compounds of fluorine or chlorine

THE conquering of cotton shrinkage is too well known to warrant detailed mention here It is enough to say that the mechanical process known as Sanforizing gives adequate control over what was once a knotty problem to the textile producer and a terrible nuisance to the consumer More and more cottons are being pre-shrunk with this process and in time all cottons may be shrunk before sale Installation of shrinking equipment has been taking place in mills all during the depression to satisfy consumer demand.

The shrinkage of wool has long been studied to devise some means for arresting it to make a more serviceable fiber. A solution to the problem seems to have been reached at last and perhaps the best



Photos Du Pont Style News Service
Rayon velvet, made crushresistant for practical wear

evidence of success is the statement that all woolen socks distributed to the fighting forces of Britain are to be given the new treatment Before discussing the process, however, it will help if we outline the phepropriete of shrighting.

nomenon of shrinking
The individual wool fiber appears
to be covered with countless small,
overlapping scales which are responsible for the interlocking of
the fibers, and, incidentally, for the
property of felling which is utilized
to make felt hats. When wool is
compressed in washing, the fibers



Water-repellency at last makes an improvement in men's coats

- SCIENCE IN INDUSTRY



become more and more entangled and close together more tightly, the process being repeated with every washing. Stripping the scales from the fiber will make wool unshrinkable but at the same time it shortens fiber life because they lose their protective covering. If a compromise is sought by removing the scales only partially, there is a corresponding loss in shrink-proofing and this falls short of the goal

The new process calls for applying sulfuryl chloride to the wool with the following claims as to action and benefits. The scales are not substantially removed but rather, their projecting ends are probably made to hold more closely to the fibers so that they are smooth and lose their felting propensities. It is also claimed that the fibers are uninjured.

Other processes developed to retard wool shrinkage are those using dry chlorine gas, and certain of the alkyl hypochlorites. But the claim for these agents is not as strong as those for sulfuryl chloride

It is very evident that research work has been directed toward the improvement of old processes quite as much as to the origination of new ones. Water-repellency and crush-proofing, for example, are not brand new, but older processes were impermanent in effect. Once a fabric had passed into consumers' hands and had undergone its first cleaning, the bloom was off and there was little to warrant paying for so brief a pleasure. The most recent developments contribute a lasting quality value to fabrics and his represents a long stride shead.

A still further step remains to be taken, however At the moment, the use of one process pretty much Liquids which ordinarily stain are not absorbed by fibers of material which has been made water-repellent. In the tests shown in these photographs, ink was flushed off with clear water



excludes the use of another. The new permanent water-repellency process can be used in conjunction with urea-formaldehyde resins to make a fabric having two imparted qualities, but for the most part processes are mutually exclusive and that limits the number of advantages given to any single fabric.

For just about a century, people have been pondering the idea of printing fabrics in the manner of printing paper so that the color is applied direct, rather than to continue with the laborious process of printing with dyes which emerge as color only after a series of chemical treatments. To get a pigment that will strike into the fabric and make a permanent bond without spreading, that will be light-



fast and wash, has eluded searchers for many generations. Such colors are now available—a lacquer type and a resin type. They are incorporated with pigments; and after printing, a drying process develops them. These new types of color are being used to print shirt materials in very large volume and the benefits are primarily those of eliminating developing processes to gain production speed.

There is hardly a phase of the highly specialized process of textile production which has not been touched beneficially by research Most achievements thus far have small interest to the consumer because the only evidence of benefit is in the overall sense of obtaining better quality and better designed fabrics at somewhat lower cost. But the end is not in sight Research came to the textle industry much later than to others and what we enjoy now is only a beginning.

Metal from the Sea

Plant Will Extract Light-Weight Industrial Metal, Magnesium. From Solution

A centuries, adventurous men have roamed the seas exploring the hidden depths for the wealth of sunken treasure. Little success has been theirs. Yet long before may even appeared upon the earth the sea was storing up treasures of a different kind—valuable chemicals and metals dissolved from the land by flowing water.

Some years ago a large plant was placed in operation at Wilmington, North Carolina, to extract some of this weathi-in-solution in the form of bromine to be used in preparation of anti-knock gasoline. Now the same company responsible for that plant is building another to extract the metal magnesium from the sea. This new plant, according



to a recent announcement by Dr. Willard H Dow, President of The Dow Chemical Company, sole producers of magnesium metal in America, will be located along the Gulf of Mexico At that point enough of the metal will be extracted from sea water to raise Dow's total magnesium production from 12,000,000 to over 25,000,000 pounds annuals.

The growth of the infant magnessum industry in America has been amazing, considering that it had its birth in 1915—only 25 years ago For that growth a great share of the credit goes to the founder of the company bearing his name, Dr. Herbert H. Dow

The growth and development is significant because magnesium, third most abundant engineering metal in the earth's crust, is an important constituent of modern light-weight alloys which are being used more and more widely in aviation, bus, railroad, and general transportation industries as well as in the manufacture of light-weight tools and many other products. The reason for this wide use is that Dowmetal, a silvery alloy, is one quarter the weight of iron, only two thirds as heavy as aluminum, and is possessed of great strength, toughness, and durability. It is speedily fabricated by all common methods.

Each one of the oceans 320,000,-000 cubic miles of water contains something like 175,000,000 tons of chemical combinations of such materials as gold, silver, copper, magnesium, aluminum, calcium, bromine, iodine, and other valuable elements. It has been estimated that these materials in each cubic

At left: Typical sea water intake which will conduct water to settling basins, the first step in production of magnesium from the sea

Below: Extruding an alloy of magneaium. It can also die cast, sorged, and welded. At right: Airplane propeller blade and other aviation parts made of Dowmetal, world's lightest, strong atructural metal





mile of water have a value of some five billion dollars if only they could be extracted Bromine is being extracted and shortly the recapture of magnesium will begin near Freeport, Texas

Up to now magnesium has been produced at Midland, Michigan, where the raw materials, from which the metal is extracted, is taken from the ground Chemists say that it can be recovered from sea water with less effort than from

the land because of the fact that the water has already done the preliminary job of washing the magnesium out of the soil

The new plant will have a capacty of 12,000,000 gallons of sea water daily, yet that plant can operate for 300 years extracting the magnesium ii, just one cubic mile of ocean water. In that same cubic mile—it is actually more than 1049 billion gallons—there are about 5,700,000 tons of magnesium.

ROND

Process Binds Rubber to Aluminum

DURA-BOND is a new process developed by Hewrit Rubber Corporation for bonding rubber on neoprene to aluminum, according to the Aluminum News-Letter Adhesive strengths up to 750 pounds per square inch can be obtained, but the process should be restricted to products which operate at temperatures below 200 degrees. Fahrenheit

This new process makes use of a chemical coating between the rubber and the aluminum which fuses the two materials together without diminishing the ability of the outer

layers of rubber to be vulcanized The metal needs no coating of hard rubber to make the soft rubber take hold, and brass plating of the metal is unnecessary

Combinations of rubber and aluminum have wide application in the manufacture of sound-proofing equipment for machinery, in the production of spark-proof oilsuction hoses and fittings, and in pickling bath apparatus

PORCELAIN-LIKE

Coatings Are Hard, Mar-proof.

Resistant to Acids, Alkalis

Two new porcelain-like finishes have been developed by Toch Brothers Division of Standard

SCIENCÉ IN INDUSTRY

Varnish Works Known as Kwuckdry and Rockloid, both these finishes are hard and mar-proof, will not chip, flake, or crack. Yet they have remarkable flexibility and not light, heat, and chemical resistance. Mild alkalis and acids do not affect them They are resistant to most solvents and possess excellent humidity resistance.

The first of these two finishes, Kwickdry, is satisfactory for outdoor and indoor use It may be used as a one coat system or over a primer prayed or bished It sets task-free in or to two hours, or may be force dried at 140 degrees, Pahrenheit, for 20 to 30 civils.

The second, Rockloid, is intended primarily for indoor coatings. It may be applied as a one coat system and baked at 350 degrees, Fahrenheit, for 10 minutes, or at a lower heat for a longer time.

STEAM CONTROL

Spinning Disk Prevents Valve Clogging

A NEW principle of steam control is incorporated in the Ostlind valve, which was announced recently The valve is the invention of Joel Ostlind The principle is said to eliminate the causes of leaky valves, rather than to resist them

The Ostlind innovation is a spinning disk, which rotates up to 2000



Pencil points to turbine vanes

ievolutions per minute for a moment preceding closing. The disk does not spin when the valve is 'cracked.' or while throtting. A reversing chamber directs the steam flow to turbine vanes just before the disk descends into the seat. The turbine vanes are shielded from the steam flow when the valve is one.

The spinning disk throws off scale and other foreign particles by centrifugal force, thereby preventing these particles from becoming caught in the line of seating. The disk hits the seat while spinning at a high rate of speed. and polishes the line of closure, creating a complete metal-to-metal contact between seat and disk, thus preventing "wire-drawing"

The disk is mounted on the spindle against a stainless-steel ball bearing, aligning the disk with the seat when closing

BETTER COPPER

Made by Plastic Conversion Under High Pressure

Announcement of the perfection of a new type of copper after a ten year research and development program costing well into seven figures was made recently by Wyle Brown, President of the Phelps Dodge Copper Products Corporation

The new copper is known as "PDCP," and was created by research to meet the need of the elec-



Ductility and smoothness of PDCP shown by rupture test

trical industry for a copper of superior characteristics Greater conductivity, ductility, fatigue resistance, and surface quality are the outstanding characteristics of this modernized metal. It is free of the imperfections of ordinary copper, which, according to engineers, have been responsible for a large percentage of electrical failures.

The improved metal is made, without melting from electrolytic cathode copper which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature, into smooth, dense copper bar, rod, strip, or other desired commercial shapes Basically of the oxygen-free type, it is the only solid copper in the world which is not melted subsequent to the electrolytic purification process. Hence, the intrinsic purity of electrolytic cathode coper is retained and enhanced

One of the principal difficulties of engineers and maintenance men concerned with copper windings in motors and transformers, is the existence of surface imperfections in the copper which, by vibration and magnetic stress, eventually penetrates the insulation and causes

failure by short circuits. These imperfections may originate in defects arising in the casting process and are normally present in the best commercial copper wire bars. In addition, slivers and oxides are developed during the process of



Twisting rod of new copper to destruction required 30 twists

hot-rolling the cast copper bars intor rods, and are more or less inherent in the hot-rolling process The new patented method eliminates not only the casting process, but also hot-rolling It has, in consequence, made possible the enproduction of a sliverless and dustless copper surface heretofore attainable only in the laboratory

PDCP copper, in common with all other coppers, is not susceptible to heat-teatment in the sense that the ferrous people use the term it can be hardened by cold work, softened by annealing It does, however, anneal at a temperature between 100 and 200 degrees, Fahrenheit, lower than other coppers In fact, protracted tests have shown that it will anneal slowly in boiling water at 212 degrees, Fahrenheit, but will anneal slowly in boiling water at 212 degrees, Fahrenheit

BY-PRODUCTS

Citrus Fruits Find Uses in Industry

A considerable amount of research has been conducted on the problem of finding a use for citrus fruit surpluses and wastes As a result, many new products have been developed, among which are the wines and liquors announced in these pages some months ago, which were developed by the Bureau of the Department of Agriculture Also, new and better types of citrus-fruit juices and oils have been developed. These byproducts have found a ready market in industry, medicine, and agriculture

Citrus juices are popular in the beverage and dairy industries Citric acid from lemons, another best-seller by-product, competes

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with Italian imports for use in beverages, lemon and orange oils for bakery goods, candy, and flavoring Sodium citrate is used by the dairy industry Citrus pectin, from the white pulp of citrus fruits, adds creaminess to malted milks and soft drinks Pectin has been found valuable, too, as a blood coagulant and as a stabilizer for the barrum sulfate used in digestive X-ray work and as a detoxication agent Pectates, close cousin to pectin chemically, have application in paper-treating, in rubber production (for creaming latex), and in

quenching steel more cheaply
Soon to appear is a new vitamin,
Vitamin P (citrin), prepared from
lemon and orange derivatives, nose
being submitted for clinical use
"Squeal-of-the-pig" is citrus meal,
made from the dried peel and pulp,
fed to darry and beef cattle, poultry,
sheep, rabbits, and goats

MACHINE CLUTCH

For Cone-Driven Machines Makes Speed Change Easy

FOUR-SPEED transmissions for application to cone-driven machine tools are announced by the Western Manufacturing Company They make changing from one speed to another as easy as when driving an automobile There are three models—a "Master" for 1 to 5 horsepower, a "Major" for 5 to 10 horsepower, and a "Super" built to specification for machines requiring larger than 10 horsepower motors I its built for heavy loads with the transmission case and covers of



Four speeds

semi-steel castings and the gears and spline shafts of alloy steel, machined to close limits and ground All of the moving parts run in an oil bath.

RALANCE

A LOW-PRICED, compact balance, that can be readily dismounted and stored in a laboratory drawer is amounced by the Clay-Adams Company This instrument has been designed to meet the needs of all balance technique, and at a price within the reach of the student in chemistry it is supplied with brass weights.

In use, the upright beam support is inserted into a metal socket in the box and the beam placed upon it. An eccentric beam release brings the pans to rest. Capacity is 100 grams; sensitivity 5 milliprams, beam, 725 inches long with steel kinife edge, support for beam is an agate bearing. Pans are 325 inches in diameter, and are notched to support test tubes.

SOLDERING

STANLESS steel, beryllium alloys, brass, copper, bronze, and other metals may be easily soldered when Geko Acid-Free Soldering Compound is used This is a new product developed by Geko Chemical Company

Geko is free of any mineral acid and is therefore non-corrosive if used according to directions It makes the first cleaning of the metal unnecessary for it creates a perfect and lasting bond even on oxidized surfaces It may be used with soldering iron, open flame, or even a match, as its melting point is quickly reached

LINKED PLASTICS

Ingenious Method for Molding Plastic Chains

Weldless chains of Tente are an outstanding accomplishment in the art of plastic molding. They are the first plastic chains of this type, and were made possible by the molding properties of Tenite combined with an ingenious mold design.

The chains are shown in our illustration in both cast and finished forms. The mold design automatically eliminates any cutting, threading, and cementing of the



Chain as cast and as finished

links—operations that are necessary in making the more common welded plastic chains. Severing the links from the runners of the casting is the only finishing required.

AUTOMATIC Carbon Arc Process Makes Better Weld. Saves Time

A UTOMATIC carbon arc welding is reported to have many advantages in the construction of aluminum tank cars at the American Car and Foundry Company plant at Milton, Pennsylvania The automatic process permits faster construction and a considerably better quality weld, together with marked freedom from distortion This development was motivated by a desire to improve quality, not to lover costs which are practically unchanged because the increased flux cost

cancels the labor saving Since no beveling of plate edges is required, the full thickness of metal is utilized in the welding by simply butting the square edges together, greatly simplifying the set-up of the work. The welding time per tank is noticeably shorter than previous methods since the automatic weld is made in two passes instead of the three formerly used. The fact that automatic welding permits welds of complete overlapping penetration accounts for the greatly improved quality of the weld The aluminum tanks manufactured by the American Car and Foundry Company have, for the most part, been utilized for glacial acetic acid service. This

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is the basic material for the manufacture of rayon and non-inflammable film. Two of the aluminium tanks have also been put into service for carrying peroxide These were constructed of 2-S (995 percent aluminium). The remainder of the tanks, for acetic acid service, were constructed of 3-S aluminium (975 percent aluminium).

RING

Comparison Tests of Metals

Under Heat

BELL made of ordinary materials gives off a dull thud when struck after being heated to a high temperature. A new metal, called K-



Test by ring

42-B, developed in the Westinghouse Research Laboratories, gives off a brillant tone under the same circumstances. This new metal is therefore being used for comparison tests of metals.

ison tests or metais. In our accompanying illustration a bell made of steel is shown at the left while one made of the new metal is at the right, both having been heated to a high temperature. While still very hot, the steel bell at the left gives off a dull thid because of the inclastic movement of its atoms which converts the energy of its vibrations into additional heat.

TESTING WELDS

Magnetic Dust Reveals

Tiny Cracks

CRACKS which tend to develop during cooling of a welded joint can be dangerous even though extremely small, since large stresses that are set up in the vicinity of the flaw lead to the extension of the crack in the metal. One of the successful non-destructive means of testing welds for flaws is the magnetic method. Under suitable conditions very fine surface and subsurface flaws as small as 1 by 10-4 centimeters can be detected by this method

The principle of the method depends upon the fact that the presence of a fault in a magnetized specimen will cause distortion of the magnetic field on the surface of the specimen. The magnetic susceptibility of the fault is much lower than that of the sound metal. and the flaw acts as an air-gap, the magnetic flux at this point being diverted into the surrounding material The leakage field at the flaw can be more strongly detected the nearer the flaw is to the surface The greatest depth at which flaws can be detected is about 0.5 of an inch.

Best results are obtained with a direct current magnetizing field where the flux passes through the flaw at as near 90 degrees as possible The type of metal used will determine whether or not the magnetizing current can be turned off while testing the weld. The detection of flaws in the weld is accomplished by means of fine iron dust which is applied to the surface of the magnetized specimen. These particles will then move to a point where there is a large leakage field or a flaw. The dust may either he blown or sifted onto the specimen, or suspended in a suitable light oil which is poured or sprayed onto the specimen The smoother the surface tested, the more clearly will cracks be shown —H Hirst. The Commonwealth Engineer and Highway Research Abstracts

CORES

Wetting Agent Reduces Machining of Castings

Non-FERROUS metals can now be cast in smooth, fine cores at a considerable saving in time. This is accomplished by the addition of a small percentage of Sulfattet, a new type of wetting agent manufactured by Glyco Products Company, Inc.

The ordinary core for casting non-ferrous metals is usually a combination of silica, sand-clay binder, and linseed oil. This type of core is very rough and necessitates a great deal of machining to finish the casting. If after bak-

ing the core, it is dipped into a solution consisting of one pint of molesses, 10 pounds of graphite, one pound of Sulfatate, and water sufficient to make five gallons, and then re-baked, the core will present a smooth surface, and the casting made from it will require little if any machinus.

The addition of the Sulfatate eliminates the necessity of hanging the core so that the excess molasses-graphite mixture will drip off. The core, when it is withdrawn from the solution, breaks cleanly.

CUTTING

Cemented Carbide Tools

Now Standardized

ROBABLY every user of cutting tools has looked forward to the time when he could enjoy the many recognized advantages of cemented carbide tools without the necessity of a large investment in special tools Although the longer service life of cemented carbide tools has proved that they do actually "low-ret he cost per piece," yet the



Bonded edges of cemented carbide in a standard tool

necessarily higher price of specially-made tools has limited their use on short jobs and general tool room

Announcement has been made by the Wesson Company of a complete line of standard carbide cutting tools. At present, these standard cemented carbide tools include reamers, shell reamers, core drills, and mills, counterbores, and inserted blade milling cutters. The are produced by a process which has involved the development of a new treatment for shanks and bodies. An important feature is hardening at temperatures which do not injure the bond or the carbide insert.



FLUORESCENCE

In: New York World's Fair offers a great spectacle of illumination, but, more than that, it has been a proving ground for new and improved lighting equipment. If full advantage were taken of the new light sources available and the general level of illumination were to be raised to adequate heights, lighting would be revolutionized.

Take just one item—the fluorescent lamp. Here is an efficient and practical source of daylight lighting Invisible ultra-violet energy, produced by an arc, is converted into visible light through the medium of fluorescent powders lining the tubes Older practice was to coat incandescent bulbs to strain out all unwanted rays, and this was inefficient. The new lamp produces about 40 lumens per watt, the household filament only 15 lumens.

Being unexcelled for color discrimination, the fluorescent lamp is used for matching leaf tobaccos, inspection and pairing of hosiery, and inspection of
color proofs Because powders can be selected to give
different colors, progressive merchandisers have a new
field for color utilization at their disposal. The lamp
radiates only one fourth as much heat as an incandescent lamp, hence it has special value for the food
industries and for show-case lighting of perishables

The fluorescent lamp is a special purpose light, not a substitute. Many units are needed for high levels of illumination, despite the high lumens per watt, because the lamp is a low-wattage type. Equipment and installation costs are higher than for ordinary lighting, but an expanding use is bringing these costs down

INFRA-RED DRYING

Not to be credited to any Fair is the infra-red drying lamp, now spreading through industry. Upwards of 35,000 of them are used to dry automobile bodies and, having proved their merit in that industry, they are now saving time in the drying of resins, inks, blueprints, paper, and latex Small portable units have been developed for drying re-decorated wall surfaces and trim in buildings. These units reduce idle time of office space.

The radiant energy near the infra-red region of the spectrum has a peculiar penetrating quality. It goes right through a paint surface to dry it from the inside out. Thus no outer skin forms to retard the process. It works quicker on dark surfaces than light, on rough surfaces faster than smooth ones. No air circulation is required, hence the hazard of dust movement is reduced. Installation costs are relatively low because standard wiring and sockets are used

RADIANT HEATING

Looks as though the same rays which dry the lacquers on automobile bodies would be harnessed to heat buildings. There are several radiant heating installations in this country, more in Europe, and commercial interests are getting behind it. There is much

to recommend it for far wider use in this country.

The principles involved in radiant heating were ducussed at length at the time of an earlier push (December 1936, page 335), but here is a brief résumé. Radiant heat is a wave of pure energy which warms objects without heating the intervening air You feel it when you stand in front of a pot-bellied stove, a fireplace, or in the suin in the wintertime In the path of these rays, man can be comfortable even though surrounding temperatures are low, because the rays are strong enough to prevent dissipation of bodily heat faster than it can be generated

Early installations called for pipes imbedded in ceilings Through these pipes warm water flowed, and the warmed ceilings radiated heat downward to envelop the occupants. A less common installation has metal wall panels heated with water, but this requires four heated surfaces per room. Newest idea is to mibed pipes in the floors. Water, heated to 85 degrees, Pahrenheit, flowing in pipes, is intended to produce a 65-degree room temperature which is adequate for

Commor.

Claims for this type of heating are many and wellfounded Installation costs are higher than for convection heating, but there is a saving in fuel, running
as high as one third, greater bodily comfort, better control of humidity Complete concealment of heating
apparatus is an added advantage. Offsetting to some
degree the higher initial cost due to piping is a possible saving in cost of heating plant. Likewise, need for
air-conditioning systems is virtually eliminated

Apropos of radiant heating is a home-cooling experiment which simply reverses the process. Room walls are covered with two black panels and a layer of aluminum foil. The foil reflects heat to the black panels which absorb it, and both panels and foil are cooled to a temperature of 50 degrees by concealed pipes. A marked reduction in operating cost of air conditioning is claimed for this system.

SHOCKING NEWS

The extreme dislike for electrical shock which livestock manifest is the cause of some concern among woven wire fence manufacturers

A single strand of electrically charged wire will keep horses, cattle, and pigs just where you want them. One or two good shocks will condition animals to give the fence a wide berth. Ergo, farmers are favoring the single wire instead of woven wire fence because of the generous cost saving. Actual installation figures are hard to get, but estimates of controller sales give a good indication. Sales have jumped from some 14,000 to 75,000 in four years and the total sales of controller devices, including home-made shocking devices, for this period is put roughly at 335,000. Probably no less than a quarter million miles of electrified fence is in operation.

How much of a headache is this for manufacturers? Not as severe as one might think. There is substitution which has cut into woven fence volume, but much of the electric fence is clear gain. The temporary use for utiliting pastures, making exercise pens, lanes, and after-harvesting gleaning areas, means additional wire sales. Also, the way is opened to fence large areas hitherto tprohibitive from the cost standpoint A rapidly growing use is for protection of existing fences. It will take time to strike a loss and gain tonnage balance. Meanwhile it is a boon to farmers and live-stock raisers.

- Philip H. Smith

Maestro of the Atom

Lawrence Had an Inspiration. So Science Now Has the Cyclotron for Smashing Atoms

LORING A. SCHULER

NE night. 11 years ago, a young associate professor named Ernest Lawrence sat in the University of California Library, plowing through reports of experiments in physics. Mostly they were routine, but one caught his see

The experimenter had hitched together two long vacuum tubes, and the speed of the electrified particles had been measurably stepped up as they jumped from one tube to the other Why, Lawrence thought to himself, only two tubes? If the fellow had hitched up ten, wouldn't he have got the impelling force of a million volts? enough, perhaps, to smash atoms? But ten tubes in a straight line would be impossibly long. Why not, instead, a circular vacuum chamber, with two half-round shallow copper boxes, shaped like the halves of a pill box cut down through the middle, as electrodes? Oscillating electric current would shift rapidly from one box to the other, a magnet would straddle the chamber, at right angles If his theory was correct, the same small voltage, used over and over again, would give charged particles a series of electric pushes, while the magnet would keep them going round and round in a compact spiral, something like the spiral on a phonograph record And thus the hopelessly long device Lawrence had first thought of could be made practicable after all The particles would go faster and faster, until perhaps they would pile up the speed needed to crack atoms

That was the birth of the cyclotron, for which the same Ernest Orlando Lawrence has been awarded the great Nobel Prize in physics as the world's number one atom smasher.

Today with two huge cyclotrons that he has built at Berkeley — vastly bigger and infinitely more complicated than what he dreamed

of that night in the library — he is helping to solve some of the most fundamental and mysterious problems of science

And in the unpredictable manner of scientific discovery, what started out to be abstract research is turning out to have such practical value that today medical doctors, chemists, biologists, botanists. entomologists and a great many other scientific gentlemen are all thumbing rides on the cyclotron because it promises to take them to places they have never been able to reach before A powerful ray is under experimental use as a hopeful weapon against cancer Artificially irradiated substances, with properties like those of radium, are being created for the study of growth and the treatment of various ailments, while in the field of agriculture plants are being made to tell how they absorb nourishment and make starch and sugar

These are measurable gains in life and health and wealth But there is much more. Lawrence

knows, to be found beyond the frontiers that he has already explored, so now he is getting ready to build another atom-smasher, 20 times as big as his biggest, with which he confidently expects to be able to reveal Nature's secret source of energy, tap enormous mew supplies of power for industry, and transmute the elements by this modern alchemy

For 25 centuries, men of science believed there was a basic, indivisible particle of matter, the atom, out of which all things were made then, only a generation ago, evidence piled up to prove that each atom was like a tiny universe, with a nucleus at the place of the Sun, and electrons whirling round it much as Venus and Earth and Mars and Jupiter and the rest of the planets whirl around the Sun All the electrons were identiced.

TURTHERMORE, it was discovered that there were as many kinds of atoms as there were basic substances - hydrogen and oxygen and sulfur and zine and tin and copper and silver and gold and radium, and so on to the number of 92 in all, which were called elements What made each one different from the others in chemical properties was the number of electron planets that each individual atom had spinning round its nucleus sun Hydrogen. for example, had one electron, oxygen had eight, copper had 29.



The 220-ton evolution at the University of California. The big chunky rectangle, with vertical pole-pieces in its middle, is the huge magnet. Between these pole-pieces is the main. "business" part of the apparatus, the circular vacuum chamber containing two electrodes, also the space where projectile particles are speeded up. Power source is on balsony

tin had 50; gold had 79; radium had 88, and uranium, heaviest of all, had 92. The elements are known in science by those "atomic numbers"

But strangely enough the electrons, which are charged with negative electricity, could be removed without essentially changing the character of the atom It would still be an atom of gold or iron, for example So, the researchers said, there must be something in the nucleus, with its positive electric charge, that we don't know about, and inquisitively they turned experimental guns against the little sun that was the center of each atom universe. Did the nucleus, too, have smaller parts? They found that it did, and named those parts protons and neutrons And said that here at last were the elemental building blocks out of which everything in the world was made Meat and potatoes, gold and iron, oil and water - all substances were made of the same protons, neutrons and electrons arranged in different patterns That statement still stands, though Lawrence may find something else when he has built his bigger cyclotron

But, it may be asked, how did the scientists themselves discover all this about particles which they could not see? Mostly by the painstaking accumulation of evidence. They could take photographs of the tracks of particles in motion, showng streaks like tmy comets, and they could "hear" two particles collide in a vacuum when the effect of their collision was amplified and converted to sound

It is easy enough to strip the electrons from an atom. The ancients did it, though they didn't know it, in that first electrical experiment of rubbing amber with a piece of cloth But smashing a nucleus is quite a different matter More than 2,000,000 atoms could he in a straight line across the dot over the letter 1. And each nucleus occupies no more space in its atom universe than a fly in a cathedral The protons and the neutrons are held together by forces of enormous strength. Here is the storehouse of atomic power. To separate the particles, so that the power could be released, would take prodigious energy. That was why Ernest Lawrence, back in 1929, was yearning for a million volts

Scientists were pretty well agreed that only an atom could be used to smash another atom. If one lot of atoms, they figured, could be made into high-powered, high-



The same cyclotron viewed from the power supply house on the balcony. Nearer cylinder is a vacuum chamber down which particles finally speed

speed bullets and fired at another tot of atoms, those that were hit might be smashed. The problem was how to get the necessary power and speed. A couple of German physicists built an elaborate apparatus to harness the lightning, they might have had something if they could have manufactured thunderstorms at will

HE virtue of Lawrence's idea was its comparative simplicity. Along in the spring after that night when he made his first sketch in the library, he got around to making a model of the device, exactly following his original specifications It was only six inches in diameter a couple of D-shaped shallow copper boxes, mounted between circular pieces of glass and sealed with red sealing wax But when the air was pumped out and a borrowed magnet was held at right angles to it and the current was turned on, particles actually did spiral round and round at increasing speed. The thing worked

Later, he built another one, a little bigger, and that worked, too, with even higher velocity Still, he wasn't smashing any atoms, but he was speeding up electrified particles to greater and greater velocities

For this he needed a magnet of tremendous size, and, though maggets like that don't grow on trees, he was lucky enough to find one that had been yunked in California when the Chinese government failed to pay for a radio broadcasting outfit of which It was a part It weighed 74 tons.

There were exciting days and

nights in the dusty old radiation laboratory at Berkeley while the first working cyclotron was being built Discouragements when it wouldn't perform according to schedule, cheers when the difficulties were overcome Parts melted off under the terrific heat that was generated, and were replaced by water-cooled contrivances. Lawrence was everywhere, driving his small crew of helpers, working like a madman himself, taxing even his own great ingenuity to devise ways of getting results without spending money

But it worked! It really did smash atoms It did more than Lawrence or anyone else had expected it would Weirdly, it performed unexpected transmutations Sodium, with an atomic number of 11, became magnesium. 12, by capturing a neutron out of a heavy-hydrogen nucleus that was shot at it Aluminum, 13, became phosphorus, 15, by swallowing an electrified particle of helium Nitrogen, 7, dropped a helium nucleus and became boron, 5, when it was bombarded with neutrons There were even more complicated changes, and as time went on the laboratory workers found that they could make five different substances out of any element that they put under fire in the cyclotron - they could add or subtract one number or two, producing absolutely different elements, or they could make a variation of the original material.

Other things happened, too After being bombarded by the cyclotron's fast-flying particles, all the lighter elements, at least, developed the curious power of throwing off rays, which only redum and its immediate family can do in nature. They were, in scientific terminology, "radioactive"

That calls for some explanation, which for the sake of clarity must start with the operation of the machine itself.

Into the very center of the cyclotron, between the two semi-circular hollow copper boxes, is admitted a stream of atoms of hydrogen or heavy-water hydrogen or helium. A tungsten filament ionizes them-that is, strips off the electrons, leaving the nuclei as naked positive charges They are caught up by the alternating 80,000-volt electric field from the cyclotron's powerhouse. But as they start off in a straight line, the powerful electro-magnet swings them into an arc. Then when they dash across the gap between the two D-shaped boxes, the quickly reversed voltage picks them up and kicks them on again

A KUNDERD or more times this happens Round and round the ions apiral in ever-widening circles, picking up speed at each half turn while the voltage reverses some 20,000,000 times a second. It is the principle of the old rope swing—with the original 80,000 volts magnified by each hundred half circles of acceleration to 8,000,000 volts. And by the time they reach the outer edge of the copper boxes the particles are traveling at a speed of 18,000 miles a second, which is \$5,-000 times faster than a rife bullet.

At the exit, a target is set up, smeared with sodium or phosphorous or some other element. The speeding ions strike the quiet atoms in the target, and, though the aim is inexact, two quadrillions — 2,000,000,000,000,000 of bullets every second, concentrating on a target of two square inches, are bound to make some direct hits.

When an atom is "smashed," the protons and neutrons in its nucleus are rearranged Here, for example, is an atom of boron A physicist would draw the picture of its nucleus as a circle, with ten little spheres inside, five of them representing protons and five of them neutrons. The atom is hit in the cyclotron by a charged particle of heavy-water hydrogen, known as a deuteron, which may be drawn as a circle containing two little spheres, one a proton

and one a neutron. The boron and the deuteron combine. There are now six protons and six neutrons, which make carbon. One substance has been transmuted into another. The new hot carbon throws off one neutron at once, in its effort to regain stability, just as boiling water throws off steam in an effort to get cool. But it still has an excess of energy, and some time later it will



The vacuum chamber unit removed from the apparatus, with its top off. Inside it are the two semi-circular, D-shaped electrodes, separated by a narrow gap and each supported by a heavily insulated support. Pipe ritting connects with the vacuum pump line. Next to right is the deficient, then one of four casters out which the ended and make the control of the vacuum pump line. Next to right is the property of the control of t

throw off still another particle.
That is radioactivity.

Some elements expel these excess particles almost immediately. Others let them stay for a while, and then toss them out, perhaps in a munute or an hour or a matter of years. Nature abhors instability, and each stom tries to regain the stability that it lost when new particles crowded into its family circle

The cyclotron makes radioactive substances easily, and from many elements The doctors pounced upon it quickly when that was discovered Radium is very rare and very costly. It can be dangerous as well as beneficient. The artificial radioactive substances have a shorter active life than radium, which is an advantage because they can be used internally with less danger. And besides they cost a great deal less - a day's bombardment of a common salt produces radioactive salt that for a day or two will do the work of several hundred thousand dollars' worth of radium

Twenty departments of the University of California are now demanding radioactive products from the cyclotron for their own

studies. Biologists are using them to study growth and metabolism. Botanusts are having fertilizers irreducted, so that they can find out how growing plants use these "labeled stome." With radioactive carbon they are learning how plants combine carbon dioxide, water, and sunshine to make starch and sugar. In insect research, so-dium is traced through the pests, In industry, radioactive platogen is helping to perfect petroleum refining, and radioactive sail can be used instead of radium and X-rays to find defects in battleshib armor

There's more and yet more Beryllium atoms under bombard-ment give up neutrons in such great quantities that a healing ray, something like the X-ray or the gamma ray of radium, has become known The doctors have already used this neutron ray with fair success to halt the wild growth of cancer cells in animals, and some of them believe it offers he most powerful weapon against human cancer that has yet been found

DECAUSE of the medical value of both the neutron ray and the radioactive substances, a new cyclotron, with a magnet weighing 220 tons, was built on the Berkeley campus last year, and 35 other cyclotrons have been built in other states and other nations

Lawrence's next cyclotron will be tagged for fundamental research, to unfold the secrets of atomic power and transmutation. Its construction will take three years, and will cost \$1,400,000, of which \$1,150,000 have already been given by the Rockefeller Foundation. Its magnet will weigh 4900 tons It will generate 100,-000,000 electron volts, perhaps much more. It will be built high in the Berkeley hills, and its operators will huddle in an underground control room, 150 feet away, when the machine is running.

So powerful an engine of atomic disintegration is dangerous as well as useful. Even the present big cyclotron—one twentieth the size of the one to come—is treated with respect by scientists. Five-foot-thick walls of lead and water protect them from flying neutrons.

When the cyclotron is running nothing moves except the atoms whirling in the vacuum chamber, and you couldn't see them even if you were at the heart of the machine. If you should stick your hand into the deuteron beam which is sometimes released as a special process.

tacular stream of bluish-lavender light you would be burned as if you had fooled with a blow torch

Will industry eventually be able to harness atomic power? There are two ways in which this might conceivably come about. Both have been sufficiently proved to take them out of the class of pure theory; neither is at all near to the stage of practicability now.

The first is energy produced by fission, or splitting, of an atom Within the past year, atoms of uranium 235, an isotope, or variety, of the heaviest of all elements, have been split by neutron hombardment which divides them into types of other lighter elements. with the release of immense energies On paper, the splitting of a uranium atom produces 50,000.-000 times the energy release resulting from the burning of an atom of carbon in coal, though researchers quickly reduce this ratio to 17 000 because of scarcity and other factors. The released energy from uranium manifests itself as heat, and if enough could be had steam could be produced to run factories

The trick will be to bring about what is called "chain reaction," which seems possible because when uranium 235 splits excess neutrons come out, and these, in theory, will attack other atoms and start a chain disintegration with a ceaseless and increasing flow of heat

So much for theory On the basis of facts now known, coal isn't likely soon to be supplanted by uranium Only uranium 235 will split and very little of this has been purified, an increase in consumption would boost the price out of sight; and, last but not least, uranium has a disconcerting high-explosive quality—because of which the Nazis are trying to lay hands on all the uranium they can find

THE other theoretical method of squeezing power from the atom is by annihiation Two electrons will diantegrate into a wave of energy when they collide. From this, physicists reason that a far greater emission of energy would result if they could make the heavier protons and neutrons kill themselves off in the same way.

Lawrence has written: "A simple calculation according to the relativity theory shows that a glass of water, if completely destroyed and converted into useful energy, would yield, more than a

billion kilowatt hours, enough energy to supply a city with light and power for quite a time."

The released energy, if it could be produced at will, would be in the form of heat, which could then be used to make steam, to turn generators, to make electricity for the use of industry.

Lawrence also says "When we can produce atomic projectiles of 100 to 200 million volts, we shall be able to unloose new energy, in light and heat We shall have new riches perhaps more important than those we have already found Radium gives off enough energy to raise its own weight of water to boiling temperature every hour, and it continues to do this for thousands of years. There is reason to hope that we shall find the means of releasing the vast store of energy in the nucleus of commoner

substances Indeed, this is more than a hope; it is already a likely possibility"

Co-workers in the laboratory Co-workers in the laboratory call Lawrence the "Maestro." He is a big man, tall and broad of shoulder, with eyes that are always busy behind his low-set spectacles, and a big, wide, toothfilled lauigh He plays a good hard game of tennis, has a cruising boat on San Francisco Bay that he won't take out unless there is rough water to make things exciting Most of, all he's curious and generous and honest, sharing each trumph of achievement with associates who love to work with him

At 38, he is in the top flight of great physicists, and, as one friend wired him on the day the Nobel award was announced "Dear Ernest, your career is showing promise"

More About the Cyclotron

For Readers Who Wish to Look Further

THE cyclotron is a sort of electrical slingshot for imparting high velocities to sub-atomic particles, in order to crack atoms apart

into its Technical Details

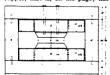
by shooting these projectiles at

The accompanying drawings reveal the essential workings of the cyclotron Inserted between the pole-pieces of the big powerful magnet, but otherwise not connected with it, is the vacuum chamber, shown in one of the photographs of the previous article The two "D's," so-called by physicists because of their obvious shape, are semi-circular, hollow, ehallow boxes, which are wide open along their straight facing sides They do not touch the chamber As the diagram shows at its left side, they are connected, as capacities, to a radio-frequency oscillator circuit, through an inductance.

To outline the essentials of the cyclotron let us assemble and operate it. First, the cover of the account chamber shown in the photograph in the previous article is replaced and sealed, the chamber is inserted between the poles of the magnet and the interior is exhausted to a high vacuum. Then a small amount of some light gas.

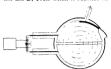
like helium or hydrogen, is allowed to enter the chamber At the center some of its atoms reach a tungsten filament which, like any hot body, gives off electrons Since this filament is maintained at a negative potential with regard to the chamber, these electrons are pushed off. They collide with the gas molecules and ionize them These ions are to be the atom-smashing projectiles.

Now to "put the ball in play". One ion, a particle having a positive charge, is assumed to be near the center—about where the spiral starts in the diagram. At this instant in the operation of the high-frequency oscillator the upper D (upper, that is, on the page) has



Courtesy Journal of the Frankin Institute
Cyclotron magnet for the Biochemical Research Foundation

attained its maximum negative potential—perhaps 90,000 volts. Therefore the particle is attracted toward it It does not travel straight toward it but is forced into a curve by the powerful uniform magnetic field passing vertically through the vacuum chamber lying between the hollow and has no wall along its parallel side, the particle does not that the Cherch we have the constitution of the hollow and has no wall along its parallel side, the particle does not that the Deven when it reaches it.



Plan showing main elements of a cyclotron's vacuum chamber

but simply enters its open interior space. This space is practically field-free, but momentum carries the particle ahead and the magnetic field curves it on around. Just as it emerges from the D, the highfrequency oscillator has changed to its opposite phase and the particle therefore is drawn again across the gap, acquiring a doubled velocity as it is attracted

The rest, for some 100 revolutions, is simply a repetition of the same performances—kick after kick that adds increment after increment of speed ("multiple acceleration") to the particle Why doesn't it travel in a circle instead of an approximate spiral? Because the radius of its are after each increase in speed is proportional to the new velocity

All these things have been taking place actually at the rate of 20,000,000 swift kicks per second Just as the long-suffering particle has decided that existence for it hereafter must be just one revolution after another, with no hope of ever attaining a permanent, fixed position in life, it has spiralled outward to the edge of the chamber Here there is a plate charged to a high negative potential, perhaps 70,000 volts This pulls the particle aside and it dashes through a mica window," thick enough to exclude the outside air but "mostly hole" for smaller things, and flies at the atoms which it is to crack in the target chamber This particle has not, however, been alone, for trillions of similar particles have accompanied it on the merry-goround. How are they aimed at their

target? They are not individually aimed at all. It is more like throwing stones at a neighbor's fruit tree in the dark when you were a boy—some of the stones hit some of the fruit—A G I

ELECTRON VOLTS

So Often Seen in Print — So Seldom Interpreted

W HAT does this peculiar term signify? Very loosely, velocity To most of us. electron volts are a new variety of volts How can volts mean velocity? Like many other common expressions, this is one that does not mean what it cave any more, for illustration, than F 45 or F 8 really means speed in a lens, instead of a ratio that can in turn be interpreted in terms of speed The amount of kinetic energy acquired by an electron when it has been accelerated through a potential difference of one volt is an electron volt. So electron volts aren't a measure of speed, after all. but of energy. It is, however, one of our mental preferences that we like to think of kinetic energy in terms of something else that we can more easily observe—that is. speed Should a newspaper reporter correctly state that "two cars met head on, with the liberation of so-and-so many foot pounds of kinetic energy," instead of "two cars met head on at 70 miles an hour." he would lose his job It is true, nevertheless, that velocity itself never smashed a car or even an atom-the kinetic energy in an object moving at a velocity is what does the smashing

To convert electron volts into miles per second requires nothing worse than doing a patch of arithmetic the size of one's hand, a complication in the calculations being the fact that the mass of a flying particle increases with its velocity (the "relativity" increase) When the particle attains velocities comparable with that of light its mass becomes considerably greater.

becomes considerably greater. Another question is: "If the particles used in cyclotrons are not electrons but other particles, according to the atom-smashing effects desired by those who operate them, why is the term 'electron' volts used at all?" The electron volt as a unit of energy can be applied to other atomic particles because the charge on any such particle is an integral multiple of the electronic charge. Here are some ex-

amples of electron voits translated into terms of speed. An electron in to terms of speed. An electron in a one-voit field would move at 389 miles a second, a proton at 8.69 miles a second, and a deuteron something over half as fast. Those, concluding the speed of course, would be slow, lazy particles. In cyclotrons the speeds read more like scores of thousands of miles a second of thousands of miles a second.

Sometimes confusing is the frequent terminology in sentences like the following "The atoms of uranium 235 are split, with the release of 175,000,000 electron volts.' Again the meaning is, simply, energy It is easier for the physicists to state it thus than in such terms as horsepower, though this could be done, and it would be as scientific Conversely, you could, after wrestling with some arithmetic. express the speed of your car in terms of electron volts, but it probably wouldn't impress the judge --A G I.

RAMAN EFFECT

Theoretical Discovery Now

Has Practical Value

ABOUT ten years ago an Indian refined equipment, discovered that the light scattered by individual molecules is not all of the same frequency as the incident light, but that a minute amount of this scattered light consists of different frequencies. When light strikes a molecule and the electrons interact with it, sometimes a fleeting change is caused in the vibrational state of the electrons This sudden change causes the "springs" holding the atoms together to jerk and so, part of the time, makes the atoms vibrate Thus, part of the energy of the incident light is converted into the vibrational energy. so that the light which leaves the molecule has a lower frequency than the incident light.

The differences between the incident frequency and the various scattered frequencies form a patitern, a "Raman spectrum." which is characteristic of the molecule doing the scattering The appearance of the Raman spectrum of a mixture of different molecules may tell a chemist what molecules are present in the mixture, while the relative intensities of the lines in the spectrum indicate the relative amounts of each. A number of new compounds have been discovered in this way. WORKER'S WEALTH —Over half the "wealth" produced in motor plants goes to workers who build the cars —Automobile Manufacturers Association, 366 Madison Avenue, New York, New York

GRAPE-FRUIT OIL —An oil with a nut-like flavor, useful in industry, cooking, and as a salad oil, is now being extracted from grape-fruit seeds—United States Citrus Products Station, Winter Haven, Florida

FREEZING WATER—Experiments prove that, contrary to a widespread impression, hot water does not freeze more quickly than cold water.—Science, p 384, (April 19, 1940)

CHAMELEON'S TONGUE—A seven-meh chameleon can capture a fy 12 mehes away without moving. His artitlery states of the control of the control of the control of the control of the mouth in much the same way a watermelon seed can be shot from between the fingers. King-shaped muscles contracting suddenly on a slippery, spike-like bone send the tongue forward—Matural History. (Max 1940)

OZONE, NO BACTERICIDE—Ozone, regardless of where or how it is generated, has little or even no effect on bacteria or germs—The Journal of the American Medical Association, p 1633 (April 27, 1940)

ANT FORTRESS —A small South American tree, the barrasanta, is a fortress garrisoned by ants A ferocious species of ants invariably live in its hollow stem and rush furiously out to attack any man or animal that disturbs the tree — O L Haught, Smithsonian Institution

SULFANILIMIDE—Experiments have shown that sulfanilimide destroys disease germs by letting them kill themselves with the hydrogen peroxide they themselves create.—Science Service. (April 3, 1940)

SMALL OIL PRODUCTION.—"Since the foundation of the oil industry, the entire world's production of crude oil would not fill a hole a cubic mile in the earth "—Dr. Gustav Egloff, Science, p 535, (June 7, 1940)

KEEP GAS OUT OF THE EARS—Rubber ear caps are now being made to protect wearers against certain war gases which, if allowed to penetrate the inner ear, would make decontamination extremely difficult it is also claimed that they will protect the ear drum from blast —India Rubber World, May 1, 1940

DANGEROUS AUTOMOBILE DOORS —Each year about 300 persons in the United States fall to their death through doors of moving passenger automobiles which they open in order to slam them shut The rush of air swings the door completely open, pulling the person out of the vehicle —Statistical Bulletin, Metropolitan Lafe Insurance Company, April 1961.

WE'RE NOT SO HUNGRY.—During 1939, the average person consumed somethings like 100 pounds less food than the average person did in 1900 Today, electricity does work in factories, homes, and farms, which used to make people develop man-sized appetities.—Dr. O E Baker, U. S. Department of Agriculture.

NEW INDUSTRIES.—Fifteen million Americans now work at jobs which did not exist in 1900—Everett S. Lee, General Engineering Laboratory, General Electric Company

BETTER FREIGHT SERVICE—Today's freight trains can do more work and do it better and in less time than those of 20 years ago. Freight cars average eight tons more in carrying capacity; locomotives average 43 percent more pulling power; and freight trains go 64 percent faster, on the average—Association of American Railroads. THROUGH THE SCIENCE LITERATURE OF THE WORLD

TO FIND MORE OIL—Around 6000 geologists, geophysicists, chemists, paleontologists, and other scientific workers, are said to be engaged nowadays in the search for oil—Thomas A Boyd, speaking before The Franklin Institute, Auril 29, 1940

FOREST FIRES FROM CARELESSNESS.—Only 10 percent of the forest fires that burn more than 34,000,000 acres every year are due to natural causes, such as lighthing The rest are man-caused —The American Forestry Asso-

RUBBER FROM HOME-OWNED PETROLEUM—"In 1938, about 1,00.000,000 pounds of natural rubber was used in this country Over 200,000,000,000 pounds of synthetic rubber could be produced from ethylene from the cracking process"—Dr Gustav Egloff, Science, p 538, (June 7, 1940)

CHEAPER LIGHT BULBS—In 1990, the cost of electric light bulbs was approximately one cent per candle power of light. In 1939, the cost was less than one sixth as much, and the power consumption less than one fourth as much, per candle power—Dr. A. W. Hull, General Electric Research Laboratory.

NO SILVER —There is no silver in nickel-silver. It is an alloy of nickel, copper, and zinc —White Metal News Letter, May, 1940

DIPHTHERIA DEATHS.—A record of no diphtheria during an entire year has been achieved by 32 cities in the United States—Science Service, May 8, 1940

TREATING SINUSITIS—While there are various preparations or treatments that are of temporary publisher with representations or treatments that are of temporary publisher with no not all cases, there is no known home treatment that a cure or competent remedy for this condition—National Better Business Bureau, inc., May 24, 1981.

SAFE RAILROADS.—A person is safer on an American railroad train than in his own home, according to statistics During the past 10 years, fatalities to passengers in train accidents averaged only one for each 1,498,000,000 miles run —Association of American Railroads

NICKEL USE.—Of the 210.194,000 pounds of nickel sold during 1939 by International Nickel, the United States alone consumed 101,200,000 pounds, or nearly half the production of the world's largest producer—White Metal News Letter, May, 1940.

CIVIL ENGINEERS—One hundred years ago there were but two main types of engineers "military" engineers concerned with the operations of warfare, and "civil" engineers engaged with problems of civil life For a time, all engineering in civil life was called civil engineering, but soon major differentiations developed . .—Engineering Opportunities, by Dr. Kaul T. Comption

An Ideal Experiment

Taking the Moon's Temperature During an Eclipse Reveals a Phenomenally Big Drop

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnerie Institution of Washington

OLD moonlight" is poetry and fact in the same phrase The Moon's light carries so little energy with it that, as a source of warmth, it is much less satisfactory than the English lodginghouse fireplace which Howells once described as having "the capacity of a pint-pot and the heating capability of a glow-worm" But modern heat-measuring devices are so sensitive that the imperceptible heat of the Moon's rays may not only be measured with precision, but afford a basis for a reliable determination of the temperature of its surface

There is no difficulty, in principle, in throwing the image of a planet, or of some portion of the Moon, upon one of the two junctions of a balanced thermocouple circuit, and recording the current set up by the heating of this junction by the incident radiation In practice, a very high degree of manipulative skill is required, to construct the tiny thermocouples. to keep the galvanometer at the highest sensitivity, and to shield the whole circuit from the many sources of extraneous disturbance Work of this sort was done years ago at the Lowell Observatory by Coblentz and Lampland, and at Mount Wilson by Pettit and Nicholson-who summarized their observations in an extensive catalogue of "radiometric magnitudes." calibrated so that from the entry for each star it was easy to derive the actual amount of radiant energy which the star sent to a given area of the Earth's surface.

The theoretical interpretation of these data is much complicated by the fact that the energy we can measure at the Earth's surface is much less than we would observe if there was no atmosphere above our heads—and if we could survive to make our measures. The

Earth's atmosphere is tolerably (though far from perfectly) transparent to visible light, but highly opaque in many regions in the ultra-violet and infra-red Hence we lose a great deal of the radiant energy from some bodies (most of all from the hot, white stars) and have to make allowance for this with much labor and pains. The worst of it is that the most powerful absorbing component of the atmosphere is water-vapor, and the amount of this varies from day to day and even from hour to hour We can get a general idea of the amount of water-vapor above us by measuring the humidity of the air at the ground level-or at that of the observatory floor-by the ordinary methods used by meteorologists. If this air was a fair sample of the great atmospheric ocean which extends a hundred miles and more over our heads, we could proceed comfortably with our calculations, but obviously when the wind is from the north high up, and from the south low down, the surface air may be a poor sample of the whole

LUCKLY, there is a "window"—or spectral region in which the air is nearly transparent—for wavelengths about 20 times as long as those of visible light. For longer waves, the atmosphere is entirely opaque, and for shorter ones it is full of regions of heavy obstruction.

This "window" comes just in the right place for the student of planetary temperatures. The heat carried by the sunlight reflected from the planet is, for such observations, only a nuisance. The heat given out from the planet's own surface is what is wanted. This radiation, coming from a surface at a temperature more or less like that of the Earth's surface, is carried mainly by long waves, while sunlight contains a great preponderance of short waves Of the two
clear spectral regions in the transmission of the atmosphere, one
lets the sunlight through, little
weakened; while the other is open
to the planetary heat—though not
wide enough to admit it all.

Our thermocouples, of course, measure the sum of both but it is easy to separate them A microscope cover-glass, 1/150 of an inch thick blocks out most of the long wavelengths, and a cell containing water between quartz plates obscures it completely-though both are substantially transparent to sunlight By interposing one or other of these screens in the path of the rays, and repeating the measures, the energy cut out represents approximately that radiated from the warm surface of the planet, and that which still gets through, the reflected sunlight Exact allowance for the small fractions of either one which are not completely stopped or let through is easy enough Needless to say, the observations must be made with a reflector, so that the rays are not obliged to pass through any glass.

In this way the reflected sunlight is eliminated, and the corrected reading represents the heat which would be received from the planet itself if the sunlight could be cut off from it for an instant, before it had time to cool.

The amount of this heat evidently depends upon the size of the portion of the planet (in squares seconds of arc) whose image falls on the thermocouple Allowing for this, there remains a quantity which depends on the temperature of the radiating surface, if the surface was a standard radiator—or "black body"— and the atmosphere was not in the way, this quantity would be proportional to the fourth power of the temperature, and the rest would be easy.

Allowance for the loss in passing, in a control to the control to the loss in passing laborious calculation, but can be reliably made (subject to can be reliably made (subject to can be reliably of the certainty of the curious control to the cont

The amounts of heat which

would be received, by a faultless detecting device, from a body of given size at various temperatures, observed through the Earth's atmosphere under standard conditions, have the following relative values:

Temperature

			Heat
°K	°C.	°F.	Received
400	127	260.6	1000
350	77	170 6	583
300	27	80 6	285
250	23	- 94	117
200	73	99 4	31
150	123	189 4	3 2
100	-173	-2794	0 048

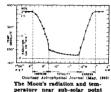
The influence of the transmission "window" is clearly seen in these figures Were the radiation unobstructed, the heat received would be 16 times as great if the absolute temperature were doubled Between 200° and 400° the ratio of increase is 32, from 150° to 300°, 88, and between 100° and 200°, it is 650.

The second secon

This adds to the accuracy of the measurement of planetary temperatures in the middle range, ear 200°K, or absolute At temperatures much below 150°K., there is very little left to measure, and at 100°K only 1/80 of the already feeble radiation reaches the Earth's surface.

This makes it very difficult to measure the true surface temperatures of the remoter planets of our system, from Uranus outward, for a simple theoretical calculation shows that they are practically certain to be below 100 K.

Taking all these things into account, Pettit and Nicholson derive a formula - which runs twice across the page on which it is printed - in which all the corrections are included. Ten years ago, from a long series of measures on various parts of the Moon's surface, they derived consistent and reliable values for its temperature The hottest part of the Moon is of course the "sub-solar point" where the Sun's rays fall vertically upon it. As we shall soon see, these rays have had plenty of time to heat it up in the week (measured by our time) since the Sun rose above the lunar horizon, and the surface is practically as hot as if would get if the sunlight kept on playing upon it forever Under these conditions, the temperature rises to 374°K (in centigrade degrees above the absolute zero), which is the same as 101° centigrade, or 214° Fahrenheit. At greater distances from this point, where the sunlight falls more



obliquely, the temperature gets lower, and the dark side of the

Moon is extremely cold
What would happen if the sunlight should be suddenly cut off?
The surface, having no internal

The surface, having no internal supply of heat of any account, would cool by radiation into space how rapidly?

Nature performs this experiment for us every time there is a lunar eclipse. The interposition of

mature persons this experiment for us every time there is a lunar eclipse. The interposition of the Earth cuts off the sunlight—not instantaneously, but in about an hour Under favorable circumstances, a given spot on the Moon may remain in darkness for more than two hours and a half, though the time during which the whole disk is obscured is about an hour shorter.

The faint reddish light refracted by the Earth's atmosphere into the shadow, which enables us to see the eclipsed Moon, is so feeble that the heat which it carries can be quite neglected, so that we have practically an ideal experiment

Lunar eclipses, visible at a given observatory, with the Moon high enough in the sky to be well observable throughout all the phases, are none too common. Pettit and Nicholson observed one at Moulison in 1927 (June 14) and the next one when weather and other conditions were satisfactory happened on October 27, 1939, and was well observed by Petti. It was not necessary to use one of the great telescopes for the observations — a 20-inch reflector collected ample energy.

The sky was very clear, the weather steady, and the Moon high in the sky Both a cover-glass and a water-cell were used to separate the reflected sunlight and radiated heat, thus enabling two almost independent sets of temperature determinations The two are in excellent agreement In the figure the squares mark the coverglass observations, the dots those with water-cell. The point observed on the Moon was not quite under the Sun, and the surface" temperature there, before the eclipse, was 99°C As the Sun's rays were cut off, the radiation from the Moon fell rapidly - almost in exact proportion to the loss of incident energy When totality began (for the observed portion of the surface) its temperature had dropped by 172° centigrade, and was -99°F An hour later it was lower by 18°C., and, just before the sunlight returned, it was -97°C... or 144 degrees below zero Fahrenheit!

r the Moon's surface were composed of solid rock, it could not cool so rapidly, for heat would be conducted up from the deeper layers, and prevent so precipitate a change Only a loose agglomerate, like pumice or volcanic ash, could interpose so effective a barrier to the escape of internal heat Such substances are just what one might expect to find on the surface of our satellite, so that there is no difficulty about believing this. Pettit calculates that the cooling during the recent eclipse, though amounting to a drop of 350°F, at the actual surface, involved mainly only the outermost inch of depth. A few inches deeper, the cooling must have been very small

During the long lunar night, the surface temperature must fall very low. The slower alternation of these changes would cause their influence to penetrate deeper, but, could we visit the Moon, and find a cavern leading into the surface, we would probably find a nearly uniform temperature, 20 feet underground.

The Earth gets as much heat from the Sun as the Moon does, and has much longer to cool down every night than the eclipsed Moon is permitted. Were there no atmosphere or ocean on our planet, its surface temperature would probably undergo almost as exteme variations. It is in more than one way, therefore, that air and one way, therefore, that air and water make our world habitable

The Temple of the Effigy

Evidences Unearthed in Ohio Afford Clear Proof of α Grisly Mound-Builder Rite

WILLIS H. MAGRATH

PREHISTORIC stone eagle effigy, the only one of its type known, according to scientists, was recently unearthed inside an ancient mound, by Roy Saltsman, an amateur archeologist of Alliance, Ohio, assisted by the author

The stone effigy, unique because of its position inside a mound, is part of the trappings of a prehistion temple of worship, and has been evaluated by Richard G Morgan, Curator of Archeology at the Ohio State University, as belonging to the Hopewell Culture of early Mound-Builders

The mound, which occupies a commanding position on the hill overlooking the village of North Benton, in north-eastern Ohio, was encircled by large sand-stone slabs set end to end. Inside this stone wall, the former existence of a second wall of wood was indicated by the charred stumps of pillars which

had supported a nearly circular building 70 feet in diameter. Entrance to the structure was on the west side, through a gateway wide enough to permit the passage of but one person at a time.

Inside the gateway was found a hard-beaten corridor bordered on either side by the black molds of the posts which had helped support the inner parts of the structure

On either side of the corridor were lines of cremated burials—
charred bones on raised, truncated earthen cones—logether with crude stone altars bearing the marks of fire On other squat clay cones, rested offerings of stone implements, mica, cannel coal, galena, and copper, while there were two

bundle burials—bones previously buried elsewhere, exhumed and brought here

The corridor ended in a square fireplace, exactly in the middle of the temple floor, over which there would have had to be a hole in the roof to carry off the smoke of ceremonial fires and the stifling stench of burning sacrificial corpses

Eastward of the fireplace, where the slanting light of the afternoon



General plan of the Temple of the Effigy

sun would strike upon it through the hole in the roof, was the fantastic eagle figure, made of white sandstone slabs resting on an understructure of molded clay It measured 32 feet across the expanded wings and 16 feet from head to tail, and was headed toward the rising sun.

Overlying the eagle's wings two skeletons were found—the one on the south that of an abnormally large male, that on the north that of a female, the latter showing marks of disease Both burnals were accompanied by rich offerings of flint, bone, and metal

Among the offerings placed with the male were a pair of spoolshaped copper ear ornaments and a platform pipe, the first such obpects to be reported from this region. The inner portions of the earspools were lined with buckskin,
secured by a twine wrapping about
the mid-section, an apparent indication that these people knew the
injurious effect of absorbing copper salts into the skin, and sought
to avoid it. A hollow copper globe
found with the female is perhaps
into the skin and sought to a sought of the second of

unique.

These two burials, perhaps those of a king and queen, were distinguished by remarkable deposits of smashed human skull fragments strewn about the feet, apparently strewn about the feet, apparently expensively and the street heat of the street heat atton, as it is not in accordance with finds made with other branches of the Hopewell Culture. However, a large horseshoeshaped stone builtorm found near

the eagle's southern wing tip bore evidence that seemed to admit of no other interpretation This evidence consisted of a litter of smashed human skulls, together with incrustations of ceremonial red paint, upon the slabbed top of the structure That wanton violence had been visited on these skulls was evident from the smashing of even such solid structures as the mastoid process, while enlinters of bone had been driven down into the crevices between the slabs. Gashes in the soft sandstone indicated that the instrument used to effect this demolition probably had been an axe

HIS barbaric altar was THIS DATORIC a.m. light of open day, under conditions that must have contrasted strongly with its appearance when it was part of a mound-builder temple Perhaps most of the rituals performed on it must forever remain a mystery, yet enough evidence remains to permit at least a partial reconstruction of what went on here when human heads were smashed and the gruesome fragments strewn at the great chief's feet. For when the great chief was stricken dead, this could indicate only that the gods were angry with the people, and it required atonement which, in the case of someone so exalted, called for human sacriIlluminated by fitful fires from the sacrificial altars, with such feeble shafts of sunlight as could penetrate the smoke reek, fantastically-garbed priests move about in the space before the curving altar, performing their offices.

The chalk-white slabs of the Eagle effigy catch the light and make a weird background for the figure of the dead chief lying upon a catafaloue of sand

Diagonally above his left shoulder for boulders have been placed to form a circle, and now a fire burns brightly in this cyst. As the flames leap higher a priest moves forward, tossing in such personal property as the chief will not want to take with him on his long journey.

Occupying a similar position is a squat respect to the right shoulder is a squat pyramid of molded clay Upon the pyramidal altar is a greenstone hatchet, a great polished celt of schist shot through with sparkles of white and yellow mica, and several lesser implements. These are the tools the chief loved and the ones he will want to take with him when his soul goes outward bound toward the rising sun upon the

strong eagle's wings

FARTHER back in this macabre chamber of sorrow—back beyond the supporting pillars and the lines of cremated burnals—are the living nobles and chiefs, while the gloom-filled area along the temple wall is thronged with still other worshippers, all of them manifesting the most poognant grief

Behind the ceremonial, horseshoe-shaped altar, facing the worshippers, is

the high priest, fantastically arrayed in towering head regalia, earlobes hideously distended with polished copper spools, swart breast hunt with gleaming shells and bear teeth. He has a pouch of ceremonial red paint, and his right hand grasps a massive greenstone hatchet.

The air pulsates with a barbarre trythm of chants and drumbeats, interspersed at times by the wild shrilling of a Pipe of Pan Guttural commands ring out and there is a commotion near the temple gate. In a moment stalwart braves enter, dragging a fright-drugged wretch whose mind is too palsaed to realize fully what is about to happen to

him in this stifling place.

The bedlam grows louder, rising to a supreme pitch as the climax of the rite approaches. The braves have dragged their victim to the curving altar, and are forcing him to bow over the slabbed top in supplication Menacingly the high priest raises his hatchet. at the same time sprinkling sacred red paint upon the altar. In a moment that altar will be redder than with any ceremonial red paint A hush falls on the crowd, the hush of emotional mesmerism. and in that moment of hush the blow falls, splitting the skull with a soggy impact, like the bursting of a rotten pumpkin Again and again the hatchet strikes. till the thing that was a human head is a shapeless crimson pulp and the body to which it was attached ceases its convulsive twitching and is still



Pieces of smashed skulls strewn about the feet of the buried Indian queen's skeleton



Part of the eagle effigy, with one of the burials lying across its half concealed wing

Contemptuously the subordinate priests kick it sade, while the high priest sheathes his hatchet. Then the dripping head fragments are gathered up and strewn about the feet of the great chief. Much of the sodden debris is carelessly overlooked, and remains upon the altar, and there the exploers find it, centuries afterward, telling its long-forgotten story.

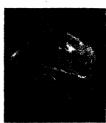
Even the Pipe of Pan, which must have played so important a part in the ceremonials, was found. It lay upon the breast of an aged man in the great stone grave north of the eagle, a beautifully made instrument, consisting of three



Pipe of Pan. Half natural size

hamboo tubes cased in a copper sheath of surpassing workmanship Since it lay upon the breast of the skeletion, exactly over where the heart had been in the long past, the finger bones of the right hand still touched it, as though the Player of the Playes had sought to protect his instrument from desecration even in death

The Pan Pipe of this ancient musican differs in several ways from the instrument of the classical peoples Where the ancient Greek Pipe of Pan had seven or more tubes, this one has but three. And, while the classic pipe has tubes of graduated length, to produce different pitches, these people made the tubes all the same length, and controlled the pitch by inserting leather plugs at varying distances from the ends of the tubes all distances from the ends of the tubes.



The "man sign" found in the

poison copper salts of the sheath, the thing has come down to us out of the past intact; we do not have to guess at it construction.

The very old man in the great stone grave was further distinguished by having at his head a large stone tablet engraved with a "man-sign" in relief. The "mansign" smacks of Mother Asia, and is used in the ideographic symbols of the Chinese even to this day Now, as for milleniums past, this symbol has meant "God" and 'Great". If the "man-sign" meant the same thing with the builders of the Temple of the Effigy that it did with their Asiatic forbears, it would indicate that they followed an anthropomorphic type of worship In this concept of religion God is pictured as a kind of superior human being, with the form of man-a relatively high culture

MOUND BUILDERS

No Longer are They

A Complete Mystery

A FULL flowering civilization, not essentially inferior to that of the Aztecs in Mexico or the Maya in Yucatan, vanished without a trace in North America, probably a few generations before the first landing of Columbus

This is the conclusion of Frank M Setzler, Head Curator of Anthropology of the Smithsonian Institution, from an effort to reconstruct out of such scattered clues as are available the history of the Hopewellians, the mound builders of the Ohio and Upper Mississippi Valleys [see also details in the preceding article—ED 1

From the results of more than a century of research, Mr. Setzler explains in a study just published by the Institution, a tentative picture can now be drawn of the ways of life of the mysterious people.

Construction of the large mounds, the surrounding earthmounds, the surrounding earthmovers and the hundreds of smaller mounds, he says, clearly required a dense population and a well coordinated society. This population must have had some stable economic basis. Even though direct evidence of maize is lacking, the practice of extensive agriculture must be admitted, because it alone could have supported the large population aggregates in which the large hopewell population aggregates in which the Hopewell population aggregates in which the

"There must also have been conscription of labor to construct mounds, which are 30 feet high, 150 feet wide, and more than 200 feet long. To obtain obsidian from the Rocky Mountains, mica from the southern Appalachians, copper from Wisconsin, and amphibians and fishes from the Gulf of Mexico. required time for exploration Since most of the large mounds were built to cover the bodies of the dead, accompanied by their nersonal adornments and other obnects, one can postulate a welldeveloped ritual, associated perhaps with a remarkable religious fervor If a select ruling class existed, they dominated a very large portion of the Mississippi Valley Copper head ornaments and colored woven garments decorated with fresh-water pearls and mica suggest insignia of authority. At least persons with such attire

would be set apart from the rest."
This strange civilization, Mr. Setzler believes, resulted from the impact of two peoples, probably without definite conquest by either. A survey of the field shows the same culture, but in a simpler form, in the lower Mussistopi Valform, in the lower Mussistopi Val-

ley and around the Gulf coast. No clue has yet been uncovered which permits the dating of this development more closely than sometime between the beginning of the Christian era and the coming of Columbus There certainly were no Hopewellians left when the first white hunters and traders came into the Ohio Valley, for not a single artifact of European origin ever has been found in the mounds. In fact, the country was then inhabited by woodland Indians who had no memory of their predecessors, or even legends concerning

them.

No evidence has been found which would indicate that any great catastrophe overtook the people. The whole civilization seems to have faded into extinction for as yet unexplained reasons.

EXAGGERATED

BEAUSE Cro-magnon man had a very large brain, he sometimes is glorified as our mental superior. From a study of his art. W H Riddell. in Antiquity, deduces that these Old Stone Age people, with 150 centuries less history behind them than we, had minds equal to those of a bright modern boy of 11 or 12 years.



The great stone grave is 11 feet leng, six feet wide, and contains approximately 15,000 pounds of dry-wall masonry. Its slab top had caved in

What Makes An Aviator?

Intelligence, Adaptability, Physique, Mental and Physical Health Are Factors

JOSEPH G. LEVINE

HEN the question "What makes an aviator?" was put to a leading pilot, he waved aside the idea that any special genius was his or contributed in any way to the making of any flier. "I think that, in the future," he said, "anyone who can drive an automobile or motorcycle safely and efficiently ought to be able to fly an airplane in safety Of course, in flying military, transport, and mail planes, perhaps something more is needed, but I do not think the idea that it takes an unusual man to fiv is at all sound." Asked to name definite qualities necessary, he stressed particularly mechanical judgment "It is the meticulous care concerning route and meteorology, and the intelligent handling of mechanical equipment that determines the pilot's length of usefulness in the air.'

An experienced army flight surgeon often gets a "hunch" from his first glance at a prospective pilot and may predict to himself, as he follows the student through his training, what kind of flier he will become.

Of course the physical constitution of the flier must reveal no defects in all the essentials. The physical examination must be exacting, and is most difficult to pass; for he is subjected to extremes in flying. There can be no history of epilepsy, syphilis, respiratory disease, kidney disease, or any other ailment that may tend to be chronic and recur. The heart, lungs. and nervous system must be sound and free from any defect. Often it is necessary for the military pilot to change direction suddenly at terrific speed. This may cause abdominal pooling of blood and brain anemia in those having a faulty circulatory system, with the possibility that the ship might be out of control long enough for an unexplained crash to follow.

The eyes should be perfect or

rendered so by a slight lens correction. There can be no color blindness, for keen vision is essential in determining terrain for landing. night flying, bombing, and in distinguishing military objectives at high altitudes. The glare of the sun from desert, water, and snow, rapid variations in oxygen tension, extremes in temperature weather; and the roar of the motor all tend to aggravate any weak condition in the near-well individual and may even affect the normal pilot This stress is tremendously increased during wartime flying

Flying has a significant effect on the middle and inner ear. The mag-



Pilot operating the device that determines perception of depth

nitude of the ear problem in aviation may be judged from the fact that pilots suffer more frequently from disturbances of this organ than from all other occupational diseases combined. The conditions of flight which most affect the ear are changes of atmospheric pressure during ascent and descent, noise, and possibly vibration. It has been pointed out that, at the present time, the atmospheric pressure factor is increasing in importance as a result of the increased climbing ability of modern aircraft. while the two latter conditions are decreasing in importance as a re-



Test of pilot with equipment simulating different altitudes

sult of recent advances in aircraft

From experience, it is known that certain types of physique may make for better fliers Medically speaking, man is divided into three classes the asthenic, athletic, and pyknic, or obese Just as an external detail can betray subtle changes hidden deeply in the central nervous system, so may facial patterns and bodily conformations serve to guide the examiner in drawing up his estimate of the applicant's constitutional capacity Asthenic, in this sense, does not mean frail but rather the lean and wirv type.

Most of the excellent fliers are known to come from the athletic group This group consistently supplies the first-grade pilots that cannot be surpassed by those of any other nation in the world

Yet it is observed that some of the superlative fliers are derived from the asthenic group. The more active glands of internal secretion of the man in this group perhaps speed up his metabolism or body processes His reflexes and power of quick co-ordination are of the hair-trigger variety. He is often proficent in all sports where nicety of judgment, finesse, and polished skill are required. He may turn out to be a crack pilot just because he is a crank for perfection

Men of the pykme type are rather unsatisfactory Their excess poundage is the visible sign of alower refers activity. Many of them may become good pilots, but, as a general rule—to which there are exceptions—they do not make top-notch fliers in emergencies they do not tend to do the right thing instinctively. It is not a question instinctively. It is not a question



Official photograph U S Army Air Corps Phorometer examination by Lieut. Col. A. W Smith, for 20 years flight surgeon and pilot

of intelligence or courage Flying is usually not the field where they excel, though they do succeed in many professions

It has been brought out that many American pilots are descended from the Nordic race group It so happens that pilots from this group are excellent aviators and are second to none of the other race groupings The Nordic comes from a cold climate. He is blond, blue-eyed, and of athletic build as usually seen in the air service There is often a piercing quality about his eyes, sometimes referred to indulgently as "eagle eye" That calm, hard, steady gaze is a quality of psychological import He usually conducts himself modestly but confidently, is emotionally stable, intelligent, selfreliant, and of the "he-man" type

The remainder, or minority, of the aviators are drawn from the Alpine and Mediterranean racial groups, and an occasional one from other groupings Their fitness for aviation varies, though not always as we imagine For example, Courtney states "A common notion abroad is that Japanese are poor fliers because 'they have no sense of balance, because their nervous reflexes are too slow" But a Japanese army flight surgeon reminded him that most of the balancing acts we used to see in vaudeville were given by Japanese "In fact," the surgeon said, "we are endowed with certain racial virtues advantageous to flying We are small and used to cramped quarters. We are agile, deft, strong Our greatest difficulty is neither mental nor emotional, but defective vision. which is a national problem "

It would be rather unfair to conclude which racial group makes the better filers Indeed, it is not likely that Nature has made any particular geographical belt the breeding ground for birdmen The flying type is perhaps evenly divided among them all. What is needed is the soil or opportunities of education and proper flying training to develon them

Military aviation is the field primarily for the young man The most suitable ages are between 20 and 30, preferably around 24. When one has learned to fly in youth. then, with the constant increase of flying experience, he can safely carry on to middle age Flying has become a reflex act with him now. and continued experience compansates for the gradual deterioration that comes with age Of course. when any factor develops that impairs his powers of co-ordination. it is then that he should wisely withdraw The man in civil life. who learns to fly at the age of 30 or later, learns with the same difficulty as one would who takes up swimming at that period He is more easily fatigued and must be given his flying instruction in small doses. His knowledge and antitude in the later years tend toward the synthetic variety

The pilot-selecting process, from the viewpoint of personality study. is of great importance. The only son, who has been pampered by his fond parents, must always be the center of attraction to be happy During flying training, he may not do well because of the discipline, and may not get along with his fellow fliers On the other hand, the young man who has been educated in the school of hard knocks and perhaps has been the leader of his gang as a boy, is to be looked on approvingly Extraneous worries, which have to be probed for, are responsible for a number of failures. It is by searching into his past life and learning how the student pilot conducts himself in all situations that one can foretell with any degree of certainty how he will act in the future

In selecting the finished plot for wartime activity, the temperament of the aviator is taken into considcation. For pursuit or attack aviation, the flier must be aggressive, with calculated, reckless daring and a flair for action with an enemy. In bombardment aviation, the more deliberate and calmiy courageous piot is chosen He must fly level over his objective for a definite period in order to drop his bombs accurately, despite the antiaircraft shells that are exploding perilously close and the enemy pursuit planes that are on his tail.

Flying skill is always influenced by the degree of conscious fear that is disturbing one's judgment. The pilot is always pitting his skill against the elements, and, in wartime, against his enemes It is this constant combat, this game or risk, that is the exhilarating recompense to those who become accomplished aviators Eternal vigilance is the price necessary for him who invides the ream of the eaging of the price in the price vades the ream of the eaging of the price in the p

A very definite type of young man is cut out for military aviation, just as in any other line of endeavor. The inherited qualities of the mind, tempered by education and experience, with the sumitated of studied foresight and precaution determine the true flying type.

50.000 AIRPLANES

How We Can Build Planes at a Rate of 20,000 a Year

It is not yet settled whether the airplane can beat the battleship, but it seems definitely settled that air supremacy means winning a war whether on land or sea Colonel Lindbergh and Winston Churchill were right when they warned the nations that German aviation was superior to military aviation of all other nations and that this constituted a menace to the world at large The President is right when he asks for 50,000 airplanes for our national defense. and advises building 20,000 military and naval aircraft in one year

But can we build 20,000 airplanes a year, even with our vast industrial resources? Yes. pro-Army and Navy methods habur of selecting prototypes and placing production orders are greatly simplified and accelerated; Army and Navy methods of inspection and approval are simplified and accelerated; Our trade schools, vocational high schools, and other schools make a great effort to train vast numbers of mechanics, Our trade unions remove their restrictions on the number of apprentices or other means of entry of new men, Our trade unions co-operate in speeding up the national effort of defense; Our universities train

the engineers that will be required in great numbers. The Allied commissions immediately impart all their war-gained information to our Air Services. Our Chief of Air Corps and our Chief of the Bureau of Aeronautics use the dictator's methods in boldly selecting certain types, and in boldly concentrating on those types, and in making up their minds quickly to guide the aviation industry, Our constructors, with/permission of military and naval authorities, follow the German alan of building planes and engines which will last 100 hours instead of 5000 hours because the war-time life of a plane is far shorter than the peace-time life of an airplane-we must maintain performance, maneuverability, and gun fire at the sacrifice of durability

The nation as a whole must willingly shoulder the cost of this program Congress should appoint a special aviation committee to function energetically and rapidly, and undertake no super-critical investigations It is better to arm in the air, with mistakes, than not to arm at all

Our young men must seize the opportunities now being offered for flight training, remembering that the pilots are the decisive factors in modern warfare and that it is somewhat pleasanter to be in the dive bomber than to receive its blasts on the march

Above all, those concerned must remember that a co-operative, energetic spirit is imperative Difficulties of production, subcontracting, machine tools, materials, engine bottlenecks, and all other difficulties will vanish provided the people of the United States, Congress, Army and Navy, and manufacturers, all understand that a stuperdious effort is necessary—A Ki

CAMERA GUNS

Two Types Permit Economical Aerial Gunnery Practice

With the greatly increased speeds of modern military aircraft, serial gunnery has become increasingly difficult. The difficulties are apparent when one considers that both target and the firing platform not only move at tremendous speeds but also indulge in violent maneuvers. Accordingly, our own air services and the air services of other countries fore more re-

sorting to training with the camera machine gun To H. K. Yulke of Fatrchild Aviation News we are indebted for an account of this interesting equipment

Two types of camera machine guns are now in use, one for fixed installations and the other for movable installation The movable camera gun simulates as closely as possible the weight, size, appearance, and method of manipulation of the regulation Browning or Colt aircraft machine guns The fixed camera gun is operated like the ordinary fixed machine gun, but bears no similarity to a real ma-



Above: Fixed type camera gun, and, below, cameras (in circles) mounted on upper plane wings



chine gun, it is mounted above the wing, near the leading edge.

Some 4000 Fairchild camera guns are used throughout the world, and their development over a long number of years has been a matter of very skilled technique Loading the film takes but an instant and is extremely easy, it is impossible to load incorrectly. In actual operation there is a maximum of simplicity. The camera starts to operate as soon as the trigger is held down. The methods of trigger control are exactly the same as in real machine guns - by pressure of the thumb in the case of the flexible gun and by handgrip pressure on the trigger switch attached to the airplane control stick in the case of the fixed gun.

A rotary disk shutter is employed and a small glass plate, on which are engraved the concentric circles of the reticle system, is located between the shutter and the focal plane. Each film magazine has a capacity of 25 feet of 16-milli-



Film frame from camera gun

meter film, sufficient for 700 shots or exposures The recording mechanism consists of a spill-second water and a cellulous film spill-second and cellulous film spill-second and four small incandescent lamps for illuminating the watch and data card at the instant of exposure Motive power for operation of the shutter tripping mechanism is provided by means of a strong sorting.

In the reproduced enlargement of a single film frame, taken during a violent mock combat, it is quite clear that the attacking plane from which this picture was taken was in a steep dive upon the target plane—A K

CRASH TRUCKS

Pick Up Aircraft After

Crashes or Forced Landings

A New and unusual type of crash truck is being built for the Air Corps by The Corbit Company. These units are to be used in salinging aircraft that have made forced landings on ground from which they are unable to take off, or aircraft that have crashed They are believed to be the largest of the type in the world, consisting of a 198-horsepower tractor unit equipped with crane and hydraulic jack, and a trailer 55 feet in length The capacity is 15 tons

At the scene of operations, the tractor is unbitched from the trailer and then moves around to the side to lift the plane aboard the trailer by means of its crane and hydraulic pack. If the plane is in soft ground, the tractor may stand on hard ground some distance away and pull the trailer in toward it by means of winches.

The transmission has five speeds forward and one in reverse in two ranges, thus giving a total of ten speeds forward and two in reverse Furthermore, the tractors are sixwheel drive

Is Your Pet Dentifrice Safe?

Most Dentifrices Are Good but Many of the Claims Made Are Not Justified

ALBERT G. INGALLS

Ew of us accept the daily war communiques literally Most of us discount their obvious untruths and exaggerations, if any, and mentally fill in omissions where we think they are not altogether frank Even though their writers should wish to do so, they find they cannot stuck to prosac fact, because the competition is so intense. They discover also that the calculated inaccuracies are accepted by at least some of the people

In the long-standing "war" of dentitrade between makers of dentitrices the competition also is intense. Some of these makers similarly have discovered that not all of the public appreciates frankness. Even the intelligentsia aren't always too intelligent when it comes to evaluating claims for merchandise. Therefore, not all the claims for dentifrices have been altogether frank, either

This is not, however, one more "awful grievance" article, since most of the nationally known dentifrices are safe. Sometimes—generally, in fact—the grievance lies only in the extravagant claims made for the dentifrice.

Just what can a safe dentifrice reasonably be expected to do? First, what are some of the things it cannot do?

No dentifrice, safely or otherwise, can keep the mouth germwise, the could kill the germs it a would damage the mucous membranes of the mouth, and even if a t could kill the germs without this damage, its effect would be transtively because the salive would soon wash it away and more germs would come in Besides, we are not as frightened about germs as we used to be.

Similarly, dentifrices cannot prevent acid mouth, because their effect is so transitory Moreover, it is entirely normal for the human mouth to be acid Just a matter of physiology.

No dentifrice can prevent tooth decay Even after an immense amount of research, science has not fully reached the answer to the question of the cause of decay in teeth, but present indications point strongly toward something related to the diet. The immediate cause. however, is the chemical action of acids on the teeth. These acids form at maccessible places in the teeth-most often between the very close, tight folds in the chewing faces-through the work of microorganisms on foods Brushing the teeth may help, but even brushing them with the best dentifrices cannot stop decay, since it does not remove the cause

Nor can any dentifrice prevent, competently treat, or cure pyorrhea This is a job for a dental suigeon—often a difficult job at that

HALITOSIS' Bad breath How can dentifrice competently treat this? It is caused sometimes by stomach disorders, sometimes by nasal or sinus disorders, infected tonsils, decayed teeth or other diseases, and is therefore only a symptom, not a disease. Treating halitosis with a dentifrice is therefore merely "treating the symptom," something the old doctor tells the young doctor never to do Of course, a dentifrice that would really cover up halitosis even if it did nothing else, would be a real boon to the world-almost as great as would have been Vice-President-Marshall's famous good fivecent-cigar-if only it would last more than a brief time after its use

Really insidous are claims for tooth whiteners, since these preparations contain acids—hydrochloric acid, for example. Nor will they always whiten teeth, since some teeth never were white to begin with Teeth vary in hue just as complexions do, and just as naturally

Massaging the gums with dentifrices may do a limited amount of good, since it stimulates the circulation, but it is the massaging that does the good. This is not, however, a fully competent treatment for hardening the gums

Use powders because your dentist does! This sounds logical but dentists do not use powders because of any inherent superiority due to their dry form. In fact, the dentist makes a paste of the powder he uses, by first wetting it Toothpastes also contain powder Dentifrices are put up in paste form, generally with glycerine as the carrying liquid, because this is the form in which the public can most conveniently use them This is not to argue against tooth powders but only against some of the claims made for them

Dentists dony that the glycerine in toothpastes softens the gums, as some makers of powdered dentifrices have said. Concentrated glycerine is, of course, always thristy it seeks water (is "hygroscopic") and will take it wherever it can get it, but the small amounts used in brushing the teeth are not considered by dential authorities to be a menace or a danger. The argument, therefore, that glycerine softens the gums is empty.

Having subtracted these main items from the total that have been claimed for dentifrices, what real values are left?

To begin with, the toothbrush tiself is the most valuable factor in mouth hygene. The dentifrice is its jumor assistant Most dentifrices contain two principal ingredients designed thus to assist one is soon as one substitute. The other is an abrasive. Abrasives must be mild, and not as hard as the teeth. A third and liquid ingredient, if the engineering described, and a flavoring agent, the fourth, helps make us want to brush our teeth when we feel lazv as most of us often do

Soap and abrasive—together, these do a lot, but a dentifrice won't cure spavins. Makers who claim little more than that dentifrices help cleanse the teeth—and there are some who do—hit closest to the simple truth, and for this alone a good dentifrice is abore than worth to us what we pay for it.

BLEEDERS

New Substance Clots Blood Instantly

BLEEDERS, from new-born babies to patients on the operating table and even, in many cases, hemo-

philiacs suffering from the hereditary bleeding disease, can now be saved by two death-defeating substances presented by Dr H P Smith, State University of Iowa

One of the anti-bleeding substances is a new preparation so powerful that, when sprinkled on a wound, it stops bleeding by clotting the blood "in the twinkling of an eve " It is obtained from beef blood This material is so fast in action that it will clot blood in one second. It is not yet on the market and the supply is still limited but surgeons at the University of Iowa have already used it, with "quite encouraging" results, to stop dangerous oozing of blood during major operations This oozing. which is difficult if not impossible to stop by other methods, is especially troublesome in operations on the brain, liver, and bone When the material is available generally. dentists will also be able to use it to stop bleeding after teeth are drawn. For hemophiliacs, such as the Spanish Count of Covadonga who recently bled to death from injuries following an automobile accident the new thrombin may prove life-saving

Thousands of new-born babies and older nationts suffering from obstructive jaundice can be saved from bleeding to death by the other substance which Dr Smith discussed-vitamin K This vitamin not only stops bleeding but, if used properly, will prevent the bleeding. Dr Smith emphasized The vitamin was discovered by Prof H Dam of Copenhagen. Its chemical identity was determined and it was prepared synthetically by scientists at the St Louis University and the University of California It was first used to treat patients by Dr Smith and by doctors at the Mayo Clinic -Science Service

THEELIN

To Speed Knitting of Broken Bones -

KNITTING of broken bones, especially in elderly women, may be speeded by treatment with the female sex hormone, theelin, Dr G A Pollock, of the Mayo Foundation, declares as a result of studies of the effects of theelin on broken bones in laboratory animals.

Women over 60 years of age get so - called "broken hips" with "striking" frequency, Dr Pollock points out. The condition, although nonularly known se a "broken ' is actually not a break of the hip but of the neck of the thigh bone near where it is joined to the hip A change in the bones of older women suggested a relation to the cessation of overion function in women past 50 years Several other scientists, Dr Pollock found, had also noted a relation between female sex hormones and bone formation -Science Service

LICKED?

New Drugs and Methods "Encircle" Pneumonia Germ

F 1938 and 1939 can be taken as representative of an established situation, the pneumonia seasonwinter—has suddenly lost much of its dread, according to data assembled by the Metro-

politan Life Insurance Company New serums, sulfapyridine and allied drugs have abruptly cut the winter peak mortality from pneumonia to about a guarter of what it was as the accompanying graph shows

"Certainly," says the company named, "the experience of these last two years augurs well for the future We

have good reason to be optimistic. in the light of the new methods for pneumonia treatment now being rapidly extended to all parts of the country Just a short time ago serum therapy was used in only a few cities and states But now the advantages of serum are generally known and applied Perhaps even greater successes may be expected from the recent advances in chemotherapy The full possibilities and limitations of the new drugs have not yet been defined, but the use of sulfapyridine and allied drugs has already yielded most gratifying results It may be that the most efficient form of treatment will be found to combine sulfapyridine and serum

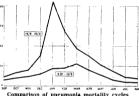
RRAIN WAVES

Practical Uses for Laboratory Discovery Steadily Increase

BROADENED use of brain-wave detection already has aided surgery, anatomy, and physiology, according to Dr. Ralph W. Gerard, associate professor of physiology of the University of Chicago

The noted neurophysiologist and pioneer in the study of brain waves -tiny electrical currents continuously emitted by the brain-enumerated recent advances through brain-wave study Detection of brain-wave irregularities diagnosing and locating brain tumors It makes possible, too, the detection of epilepsy in its first stages. The anatomist can detect the nerve tracts which carry stimuli from various parts of the body to the brain, while the physiologist attempts to find out the why and how of brain waves, and has at least partly succeeded

Recent research on brain waves has revealed that the temperature of the brain cells increases the rate of their electrical rhythm,



possibly with some bearing on the use of artificial fever in treating insanity that sedative and anesthetic drugs producing sleep slow the rhythm, while caffeine steps up the waves to more than ten times their normal size

BLOOD RAYING

Infected Blood Now Taken Out.

"Sun"-rayed, Put Back

blood poisoning and some other infections are being treated by removing some of the patient's blood giving it a quick treatment with ultra-violet rays, and returning it to the body at once Dr George Miley, Philadelphia physician, recently announced method's success

This is not in itself a new treatment but one that previously failed the rays did not reach clear through the blood treated. Success resulted when a system of baffles kept the blood turbulently turning over

Why Universal Fingerprinting?

Desirable Features of System Far Outweigh Erroneously Imagined Criminal Aspects

FREDERICK KUHNE
Former Bergeant, Bureau of Identification Police
Department, City of New York Author of

THERE are only two reasons why anyone should object to the enforcement of a universal finger-print law Either he wishes to cover up some past wrong-doing, or he is afraid that sometime in the future he may be guilty of a viola-

future he may be guilty of a violation of law. In either case he knows that registered fingerprints could well be the means of bringing him

to justice

On the other hand, every honest and upright person, citizen and alten alike, should welcome a universal fingerprint law Through reenforcement would come many personal as well as national advantages, the most important of which are outlined in the following paragraphs When these advantages are fully appreciated, there should be little opposition to universal fingerprinting, indeed, there should be increased demand that such a system be inaugurated with a minimum time loss.

It is undeniable that much of the popular opinion against universal fingerprinting arises from the erroneous impression that fingerprinting is indelibly linked with crime. That it has been of tremendous value to law enforcement officers in connection with criminal cases is, of course, true But it must not be overlooked that the lessons learned in this work can be and have been applied in non-criminal work to the great benefit of the honest private person Fingerprinting, proved an infallible system for establishing identity, has made possible positive identification of amnesia victims, unknown dead, missing persons, and so on And who can forsee when some accident, some unpredictable event, will make such identification desirable in his own case?

Fingerprinting of all military forces during World War I, plus the voluntary filing of several thousands of prints in the Civil Division of the FBI, has done

much to lessen public objection to the system. There is still a large majority of residents of the United States, however, who feel that compulsory registration of fingerprints would violate their constitutional rights. Hence the following summary of some of the favorable aspects of universal fingerprinting and recording under government control

Such a system would do away with the present expensive method





Persistency of fingerprint ridges is demonstrated by these two prints: one at left was taken in 1892; one at the right in 1922

of taking the census every ten vears. The records would give a continuously corrected census of the nation, divided by states, counties, cities, towns, and villages.

It would also give a complete record and control of the movements of all persons in the United States, whether resident or entering or leaving. It would prevent the deported from re-entering and the fugitive from leaving the country. It would prevent the falsification or forging of pasports and would serve as a deterrent to other infractions of the law.

With universal fingerprinting in force, any national emergency could be met with little loss of time. The records would make possible a speedy call to arms and would prevent draft dodging. Furthermore, those in authority would be able to compile records showing the exact numerical strength of every classification of persons, together with ages, occupations, and other important information.

Record files of a universal fingerprinting system would be of great value to the post office From them could be obtained correct addresses for improperly addressed mail, thus materially reducing the amount of mail sent to the dead letter office and hence reducing the cost of maintaining this office

Civil service applications could be acted upon with speed and accuracy from the data supplied by fingerprint files. With this information available, it could be definitely known at all times that only honest persons would secure appointments to this important service

Couple the foregoing with the more obvious applications of universal fingerprinting to the curtailment of criminal operations and we find a multitude of favorable reasons as against the few and erroneously conceived unfavorable reasons

Establishment of a universal fingerprinting bureau might appear to be a gigantic proposition It would be, however, an undertaking no greater than our present system of handling the mails, and the cost would be negligible Post offices, which are equipped to serve every resident of the United States, could be used as headquarters for fingerprinting those who reside within each postal district Thus there would be no additional expense incurred so far as office space is concerned and the money saved, by abolishing some of the present activities which would no longer be necessary under universal fingerprinting, would more than pay for the additional help required to handle the routine of fingerprinting

THE system of enforcing universal fingerprinting could be worked out through the post offices in somewhat the following manner All present residents would be required to report within a specified time to their local post offices. Here two sets of fingerprints would be taken, one to be forwarded to a central bureau at Washington, D. C. and the other to remain on file in the district post office. When a resident moves out of a postal district, it would be compulsory for him to notify the postmaster to this effect, giving the date of his' removal and the address to which he is moving. Upon receipt of such notification the postmaster would then enter such changes on the fingerprint record and would also notify the central office. If a resident is to move to some other point within the same postal district, the duplicate print would remain in

-MISCELLANY---

the local office. If, however, the new address is within another postal district, the print would be forwarded to the postmaster of the new district so that the record would be complete at all times.

Of course, it would be a necessary part of a universal fingerprint law that each resident of the nation should be required to carry an identification card containing appropriate data. This card should also bear a simultaneous plain impression of the right index, middle, and ring fingers, similar to those now used by banks and the postal

savings department

Thus it will be seen that a universal fingerprinting system could well be established in the United States with a minimum of expense and a maximum of desirable results. The advantages that would accrue to the average resident would, indeed, far outweigh any residual feeling that he might have regarding the criminal taint of fingerprinting, particularly when he realizes that this taint is one that should long since have been discarded as having no foundation in fact.

HEALTHIER PLANTS

Vitamin-Hormone Stimulant

in Powder Form

FROM the Horticultural Department of the American Chemical Paint Company comes news of the commercial production of a vitamin-hormone stimulant, Transplantone, for plants, that not only invigorates old roots but also multiplies the production of new ones, reduces the loss which frequently occurs with transplanting operations, and reduces wilting It is applied to rooted plants to add to existing root growth and to force their general growth.

Transplantone is a water-soluble powder impregnated with Vitamin B-1 and other parts of the Vitamin B fraction, plus rootpromoting hormones. The hormone initiates root growth and plant physiologists assert that the Vitamin B chemicals are necessary for the maintenance of their growth That it is quite concentrated is obvious for it requires only one level teaspoonful to a gallon of water to make a stock solution which is then further diluted. Seedlings may be lightly sprinkled weekly, or it may be applied to plants set out in the soil, whether they be trees, shrubs,

TONIGHT

They're Playing Under Lights!

bu Westinghouse



- · Few fans ever dreamed the day would come when after dinner they could ride out to a stadium and watch a professional baseball game played under lights
- · Yet, the idea of night baseball was advanced as early as three decades ago. True, nothing was done about this so-called "fantastic dream" then. But twelve years ago, a minor league club toured the country with a portable lighting system and played before fans at night in much the same manner as a carnival troupe.
- · Night baseball at last became a reality. And it proved increasingly popular, evidenced by the fact that in the past ten years it has developed in the minor leagues to a point where seven games out of every ten are today played under lights.
- · In 1935 night baseball graduated to its first major league park. So rapidly has it caught on here that eight of the big league parks are now equipped with the most modern lighting facilities. And we are proud to say that five of these lighting systems were designed and installed by our own company.
- · One has only to check the turnstiles to appreciate how eagerly the

- public has taken night baseball to
- · In 1939, for instance, nearly one million persons attended major league night baseball games. The night games at Shibe Park, Philadelphia, topped the daytime attendance average five to one. In Comiskey Park, Chicago, the first six night games drew over 188,000 paid admissions
- · There has been similar enthustastic response to night games played in the Polo Grounds, New York; Sportsman's Field, St. Louis; Forbes Field, Pittsburgh; as well as those at other baseball parks.
- · Consider if you will the unusual demands of a lighting system that must provide glareless illumination for a fast night baseball game.
- · At Forbes Field, Pittsburgh, our most recent installation, more than 210 million candlepower of light is spread over the field from 864 floodlights, each of some 1500 watt capacity. Their combined output would be enough to light every home in a city of 25,000 population. If this light were concentrated in a single unit it would make a newspaper readable more than 18 miles away. Distributed as it is, the illumination over Forbes Field is 19 times brighter than the average business man's desk
- · Fortunately, we at Westinghouse were able to bring to this exacting problem a long and highly varied lighting experience Through the important contributions we have made to better lighting, stores have been made more attractive to shoppers; factories and offices more efficient for employees; school rooms more conducive to study; public thoroughfares, airports and river docks infinitely more safe.



Engine vibration in marine installations is not transmitted to the ship's propeller when this new type of electric counting is used Built by Westinghouse, the coupling consists of an armature connected solidly to the engine shaft and a field connected to the gears that turn the propeller. These two rotating parts are separated by a small air gan; when the armature is rotated by the engine, magnetic forces are set up which turn the field (shown at left) and hence turn the propeller shaft of the ship

wines annuals or perennials In the case of plants which are set out without a ball of earth, the manufacturer recommends that the roots be soaked in the stock solution for an hour Treatment usually results in vigorous and extensive root growth and this, in turn, rerelief quires more frequent watering than

is ordinarily necessary The manufacturer further claims that, owing to frequent clipping, grass is unable to produce enough vitamin and hormone naturally for the roots and that watering with an ounce of stock solution to three quarts of water will improve turf quality Sods similarly treated before being set in place will also readily form new roots-C F Greeves-Carpenter

HEROIC CASTING

Largest Ever Cast in Strinless Steel

A BRIGHT new symbol of America's free press, the first heroic sculpture cast in stainless steel, was unveiled recently on the facade of the Associated Press Building by Nelson Rockefeller, before a distinguished assemblage Kent Cooper received it for the Associated Press

This 10-ton plaque of bright metal was made from the winning design in the Rockefeller Center-Associated Press open competition for a sculpture symbolizing news and the press Its designer was sculptor Isamu Noguchi

The 23-foot by 18-foot model, sculptured by Noguchi in plaster, was but a beginning for eight months of labor by engineers. metallurgists, molders, machinists, and polishers who blazed new trails in perfecting the technique that made possible the jump from a few hundred pounds, the largest preceding art work cast in stainless steel, to this titanic 10-ton bas-

Completion of this panel marks several "firsts" in the artistic, architectural, and metallurgical fields Noguchi is the first American artist to use cast stainless steel as a sculptural medium, and the Rockefeller Center architects are the first to demonstrate the use of a light-reflecting metal to replace the traditional light-absorbing stone and metal decorations of buildings The General Alloys Company, pioneers in stainless steel, solved many technical problems involved in casting this panel which is twenty times larger than an; previously cast The work involved the engineering of special equipment, the development of synthetic sands to withstand the terrific heat of the molten metal. and powerful precision grinding machines to achieve "invisible" joints in the finished plaque

FLOOR SEALER

Finish Penetrates Wood Grain. Gives Protection

An attractive and durable finish for unfinished floors has been put on the market by American Asphalt Paint Company. The manufacturer claims that it furnishes absolute protection against dirt,

water, grease, and constant wear.

Through its active penetration into the wood this new finish. which is called Valdura Floor Sealer, seals the grain and gives a waxed and polished appearance. with no surface coating to wear off. Therefore, floors finished with it are said to retain their original color, or natural wood finish

Valdura Floor Sealer can be apnlied with a mon or a brush. One coat only is needed, and one gallon covers about 800 square feet of floor surface. Three or four hours drying time is all that is necessary before the floors are subjected to foot traffic The sealer may also be used to advantage on logs, knotty nine, creamery churns, and other unfinished wood

BATTERY CONDITION

Indicator Shows When Battery May Fail

To protect car owners against the yearly toll of battery failures due to overcharge or undercharge, an accurate, dependable 'battery condition indicator" has now been refined and made available for use on the dash of any automobile as an accessory

This new instrument - called Charge-Master - indicates to the car driver the state of charge of his battery when at rest When the generator is charging, the instrument shows promptly any variation in battery charge, in generator performance, and in load (such as radio, heater, and so on) on the electrical line. It shows overcharge and undercharge - each of which may shorten the life of the battery and, if pronounced or continued over a long period of time, may disable it beyond repair

Charge-Master installs on any car, bus, or truck in about 10 min-



Arrow points to battery condition indicator on motor-car dash



For storage battery protection

utes The wiring is simple The instrument is self-illuminating whenever the dash lights are turned on

Car owners too often have unfairly blamed good batteries and good service men for sudden hattery failures and repair costs due to heretofore unindicated overcharge or undercharge This new device lays the blame where it should be, tells when to turn on or turn off the electrical load from radio, heater, lights, and other equipment in order to hold line potential and battery charge within safe limits until a preferred service man can be reached for timely preventive service

DUST MASK

In an attempt to provide adequate protection against air-borne dusts. pollen, or certain bacteria which annually cause untold suffering and the loss of millions of dollars. an American Optical Company research scientist - W H Lehmberg - has designed an exceptionally light and efficient filtering device for wearing over the nose and mouth to protect the respiratory system

Weighing only an ounce and a half, and excluding particles of dust as small as a micron -- 1/25,-000 of an inch - the device was developed to give comfortable protection to those working in dusts. persons allergic to pollens causing hay fever or asthma, and doctors, nurses, and patients exposed to certain air-borne bacteria

The high filtering efficiency of the new respirator is actually needed, because silica dust now generally considered harmful to the lungs is approximately five microns or less in size, common pollen grains which cause hav fever and asthma range in size from 10 to 100 microns, and bacteria are approximately one mi-

The effectiveness of the new mask, which is lighter than any

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MIRCELLANY-

other of equal efficiency, is due to four factors: A new method of making the filter unit, resulting in an extremely large, efficient filter area for the size of the mask, a new and efficient exhalation value, a new self-equalizing double headband which holds the mask securely but comfortably against the face regardless of the position of the head, and a facual design that enables one to wear the device with perfect comfort

FOLDING BICYCLE

For Ease in Carrying

Those of us who were growing up in the days before the automobile era may wish that when we were young there had been available a folding bicycle such as the Compax Sports Traveler recently announced by the Westfield Manufacturing Company Not only may this bicycle be taken apart in 15 seconds without the use of tools. but, because it has no top-cross bar, the one model fits adults and juveniles of both sexes Because of its compactness when folded up. it can be carried conveniently in automobiles, busses, trains, and



Simple joints for folding

other conveyances. That is an important advantage in these days when many people must travel to the country for their cycling.

The single cross bar of this bicycle, running from just beneath the handle bars to a point on the rear half just above the sprocket, has a slip joint with a single nutfor tightening. The machine breaks, apart at this point so that the twowheels may be folded together while the handle bars will swing downward for greater compactness.

PEEP-SIGHT

Gives One-Way View Through Front Door

A LARMED by the appalling growth of attacks on housewives by criminals who ring doorbells and force their way inside when the door is opened, police throughout the

country are warning women and all householders in urban areas to be on constant guard against this menace

Various protective methods, such as doorchains and special latches have been suggested, but a very



Protection for the housewife

effective new device is an ingenious affair called the "Protective Eye"

This safety device takes the form of a handsome and entirely innocent appearing door-knocker. In its center is hidden a bullis-eye of "one-way glass," making a tmy window which enables the house-wife to look out and see any caller without that person being aware of the inspection Having surveyed the caller, she can refuse to answer the summons or open the door as her undernot dictates.

The secret of the "Protective Eye" lies not only in the inconspicuousness of the glass but in the fact that it has one-way vision That is, you can see outside from the inside, but not inside from the outside.

TREE PROTECTION

Spray Coat Reduces Dehydration

A NEW tree spray called Protex is being offered by Protex Industries. Inc It was first successfully used at the New York World's Fair. and officials praise it highly as a spray to reduce dehydration and obviate excessive pruning It does not wash off the tree and prevents excessive transpiration without restricting respiration. The makers recommend Protex as being superior to burlap, straw, or other wrappings in extreme temperatures In addition to a winter Protex, a summer consistency is also available and is designed to prevent sun scald or scorch. The product is a rubber compound and forms an elastic coating that reflects the rays of the sun, thereby preventing wide extremes of temperature.—American Forests

WOOD STOVE

New Principle Achieves

DEVELOPMENT of a new type wood burning stove, capable of heating two or three rooms and requiring filling only once or twice a day, is regarded by New England foresters as bringing new hope to farm woodlots which have long suffered for lack of a suitable market for cordwood.

The new stove, developed by the Connecticut Forest and Park Association in co-operation with Prof Lauren E Seeley, Yale heating expert, burns wood at an estimated 90 percent efficiency. Because of a radically new design, the heater operates on the principle of "destructive distillation," burning both gas and charcoal formed in its operation.

A cord of hardwood has fuel value approximately equal to that of a ton of hard coal. The heater. shown in our illustration, will hold about two and one-quarter cubic feet of wood, or more than 50 pounds Small-diameter trimmings from sawmill operations or from "weeding" the family woodlot are recommended in preference to the larger chunks commonly used in wood stoves As wood is burned in the combustion chamber at the bottom of the stove a fresh supply is dropped automatically from the reservoir above, producing steady



Note the fuel reservoir in this efficient wood burning stove, for homes, garages, and camps

-MISCELLANY-

heat for long periods without reloading.

Prof. Seeley estimates that the heater will generate heat sufficient for two or three rooms in cold weather—for an eight-hour period without attention. In mild weather the heater will easily run more than 24 hours without attention—Science Service.

GARBAGE GRINDER

A NEW under-the-sink garbage shredder has been developed by the In-Sink-Erator Company. It is designed to eliminate the unsightly and smelly garbage pail, for all garbage is simply dumped into this device and when the motor is



switched on the garbage is so ground that it may be washed down the drain This includes such things as bones and fruit pits

The shredder head on this device, which is powered by a 1/4 horsepower motor, operates alternately in one direction and then in the opposite, so that garbage is cut either into very tiny pieces or pulverized It is connected with the house wiring system and requires during the very short time it operates only about as much power as the average electric iron.

ELECTRICAL HAIR BRUSH

While it is not possible to say definitely whether vigorous brushing of the hair has any great retarding effect on the advancement of baldness, such brushing is often recommended to stimulate the scalp and give tone to the hair For those who believe that stimulation of the scalp does assist natural growth of the hair, the Hershey Manufacturing Company has just developed a power-driven



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-MISCELLANY-

scalp brush. The several rows of bristles are so driven, at 5000 strokes per minute, that a definite cyclic sequence is maintained.

There is at present a professional model of the Vitabrush, a portable model for home use will soon be available.

COTTON WRITING PAPER

BETAILS are as yet unavailable as to the new process for making a high quality writing paper directly from cotton - low-grade cotton, at that - but the development work was done by the U S Department of Agriculture in co-operation with the Writing Paper Manufacturer's Association Provided that the process is a commercial success and paper can be made cheaply enough to create a big demand for it, then this should solve a sizeable part of the problem of what to do with America's surplus cotton



Seals Up Water-tight

and Warm

A LIFE-SAVING suit of a new design has been invented by a Swedish engineer, Count H G Morner The Morner life-saving suit is used of water-proofed fabricular to the saving suit is used of water-proofed fabricular to the saving suit is used of water-proofed fabricular to the saving suit is used to the saving suit in less than one minute, the inventor claims, but it is intended to be worn by seamen all the time al-



Designed for seamen, this lifesaving suit is quickly closed by means of a "zip" fastener



Count Morner and life-saving suit with kapok-wadded vest

though open, while the ship is in a danger zone its buoyancy is do a special kapok-wadded waist-coat, sewn into the suit, which keeps the short was the suit of the suit in the suit. Besides keeping the person afloat, the suit Besides keeping the person afloat, the suit warms him while he is in the water, and it also prevents him from freezing to death if and when he is rescued in life-boat or raft.

ROCK-PILE RESERVOIRS

Ancient People Collected Drinking Water on Rocks

THE British dew ponds described in the Industrial Bulletin of June. 1938, were not the only means of extracting water from a moistureladen, but stingy, atmosphere According to a recent issue of Discovery, medieval townsmen of Theodosia, a Black Sea port on the southeast of the Crimea, obtained sufficient water for a flourishing city by erecting, on the near-by heights, great piles of broken stones upon which the moist breezes from the sea would condense some of their water Thirteen of these piles, connected with the city by a system of sandstone pipes, supplied 16,000,000 gallons of fresh water daily and permitted Theodosia to become the most important port on the north coast of the Black Sea

Barbaric conquerors permitted the stone piles to become overgrown with vegetation, which destroyed their effectiveness It was

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-MISCELLANY---

not until the later nineteenth century that the purpose of the piles was again learned and efforts made to restore them to usefulness Modern engineering methods were not, however, immediately successful in duplicating the empirical work of the original builders, one attempt to do so failed and thereafter political conditions prevented further efforts

Successful construction of both dew ponds and stone condensers depends upon secrets which are not yet common knowledge Yet the theory of their operation is simple and a determined effort might cut through the time-fostered traditions of failure Successful operation would bring life to many an arid seacoast locality and to coral islands whose porous substructure will not permit retention of water, even though rainfall is ample -The Industrial Bulletin of Arthur D Little, Inc.

SCREEN

Dazzle-Damping

and Insect-Proof

THE newest thing in window screen materials is something like a miniature Venetian blind. Called Koolshade, it is made of horizontal flat strips of bronze, woven together every half inch with vertical



Section of bronze wire-and-strip window screen, enlarged 20x

bronze wires The spacing is the same as in the standard 18-mesh screen and is, therefore, equally insect proof

The horizontal flat strips serve to kill some of the glare of brilliant summer skies, but let in plenty of light horizontally.

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Light Control With an Electric Meter

THE mere purchase of an exposure meter of the photo-electric type, today generally regarded as the most efficient method of light measurement available to the practical photogra-pher, is by no means a guarantee against incorrect exposure—unless the meter is properly used. It is not enough merely to point the meter; it must be pointed toward the subject with due regard to the angle at which the meter is held and its distance from the subject Furthermore, many workers fail to take advantage of the various methods by which the pho-tographer may truly obtain the full control of exposure that his meter can provide for him

Beginners usually start off by deciding on the particular subject matter they wish to photograph, pointing the meter in that direction and adjusting the camera settings in accordance with the reading thus obtained What happens" If it is a landscape with beautiful clouds in the background, the foreground is frequently underexposed If it is a portrait, outdoors or indoors, the face is either overexposed or under-exposed, depending on the brightness or darkness of the background

The reason lies in the fact that a camera view encompasses a variety of light intensities, which may range from very dark shadows to very bright highlights, whereas the meter is calibrated at a definite reflection factor Therefore, because the meter encompasses more or less the same area as the camera, when held at the camera position it will take in a great deal of light from the sky, as in a landscape, and much less from the foliage, etc. The result is an "average" measurement that is of no use at all because the light from the sky will be relatively so strong that it will greatly overbalance the light coming from the foreground As a result, the sky reading is favored and under-exposure for the landscape proper is bound to result Similarly, in the case of a portrait outdoors, a reading from the camera position will take in the background and surroundings as well



Book was lowered to take a reading of shadow side of face



". . . approaching the subject closely, regardless of camera position . . ."

If these are much brighter than the subject, as in the case of a sky or a sunlit wall, the portrait subject will be under-exposed, if, as in the case of a background of dark foliage, they are less brilliant than the subject, the latter may be over-exposed

Since the objective in light measurement is to obtain a proper reading for the most important part of the subject and to allow the exposure latitude of the film to take care of the rest, it must now be clear that in order to get a well exposed landscape, or portrait, the light reflected from these



Latest in meters

subjects alone must be measured Trus is usually accomplished by tilt-ing the meter slightly, toward the landscape, excluding the sky, in the one instance, and approaching the portrait subject closely enough with the meter, regardless of the camera postion, to include within the meter angle only the face of the person being photographed A convenient rule for taking readings of objects at close range is to approach the subject to within a distance equal to the width of the subject to

Sometimes, however, it is not possible to approach the subject closely enough for proper reading. In such cases, the substitution method of meter measurement is used. If there is a tree or a house in the shade across the water that you want to include in the water that you want to include in its take a reading from your own clothing or from a tree nearby and use this reading for the exposure.

Where it is not possible to obtain a meter reading of the direct reflection from the subject, it is useful to read the incident light, that is, pointing the meter towards the light source itself. In the latest meter to appear on the market, General Electric's Type DW-48, provision is made for making readings of this type direct. A self-multiplier is incorporated in the acculator which automatically multiples exposure when the meter is used on the meter is used to the proper of dim light. (See "What's New" for dim light. (See "What's New" for

How other electric meters may be calibrated for use in reading incident light is suggested in the following experiences of C. W Gibbs, A.R.P.S.

periences of C. W Gibbs, A.R.P.S.
"In my experiments, I used the
Mini Photoscop. This meter is cali-



Extreme brightness range such as this requires care in exposure

brated in American Scheiner figures In my first trials a Kodaffector was set up exactly six feet from the subpect. Two small flood bulbs were employed. The meter was held near the subject's face and pointed toward the lights. The meter reading was 9 This value was jotted down and then a series of exposures was made on Super XX film The films were developed in X33 for the correct time to give a gamma of 7 Upon examination it was found that the exposures were fairly good through a range of from 1/250 at f/2 to 1/250 at f/5 6 Setting the meter to these ex-posures and then seeing what film speed was equivalent to a reading of 9 it was found that these exposures would have resulted from a setting of 17 and 26 For normal use, then, we would consider the Super XX to have a speed half way between these two values If the light were dull or if we were compelled to shoot at a higher speed than normal, we could see by setting the film speed to 26 if we would get a good negative or if it would be thin If the latter, we could compensate to some extent by prolonging the development time

Any given scene may receive several different exposures, each of which will be considered correct for the result wanted, and this without regard for the general over- or under-exposure of the full image A subject reflects highlights, shadows, and middle tones. If the brightness range is longer than the latitude of the film can take in at once, the worker has a choice of three procedures. He can read the shadows or the highlights or the middle tones and use each reading as a basis for exposure of the whole. The fact that film has a tone range from 1 to 128 is used in a practical way on the dial of the Weston exposure meter Besides an arrow provided for normal readings, there is a letter U and an O at either end of the indicator scale on the dial. By using this meter to read



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MAKING out-of-the-orditins Kodak Monitor's 1/400second shutter That's fast enough to 'stop' most action so you get pictures full of move about as treely and naturally as though there weren't

move about as freely and naturally as though there weren't a camera in sight. And even on dull days, you get surprisingly good results—your lens is swift, precise

I-lim-centering mechanism, double-exposure prevention device, body shutter release Pictures are by sizes below. PBICES With Kodak Anasigmat Special //4 5 lens and Supermatic shutter, Kodak Monitor Six-16, for 2½ x 44-inch pictures, 48 8 50, Six-20 model (22 38 8 cm pictures) and produce of the pictures of the picture

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'N this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPE-CIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners These special awards will be given in addition to the regular prizes that the pictures win

34 PRIZES PLUS Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people. animals, and so on Portraits will be grouped in this division Division 2 Landscapes, including all scenic views, seascapes, and

so on Division 3 Action, including all types of photographs in which action is the predominating feature

IN FACH OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS WINNERS OF THESE PRIZES BECOME AUTOMATICALLY
ELIGIBLE FOR THE THREE SPECIAL AWARDS

RULES of the CONTEST

- 1 The groups will be judged independently on the basis of pictorial pendently on the basis of pictorial appeal and technical excellence The decision of the judges will be final In case of a tie for any prize, duplicate prizes will be awarded to
- the tying contestants
 rints must not be smaller than 5
 by 7 or larger than 11 by 14 inches All prints must be mounted, otherthey will be returned wise the
- 3 Photographs must be packed prop-erly to protect them during trans-portation
- 4 Non-winning entries will be re-turned only if sufficient postage is included when the prints are submitted
- mitted

 Beach entry must have the following
 data written on the back of the
 mount Name and address of contestant, type of camera, and film,
 enlarger and paper used

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- 6 Contestants may submit no more than two prints in each group, but may enter any or all groups In no will more than one however award be given to any individual contestant
- 7 Prints must be in black and white
- Color photographs are not eligible 8 Prize-winning photographs will be-come the property of Scientific American, to be used in any manner at the discretion of the pub-lisher
- 9 Scientific American reserves the
- right to purchase, at regular rates, any non-winning entry 10 No entries will be considered from
- professional photographers

 11 All entries in this contest must be
 in the hands of the judges by
 December 2 1940 Results will be announced in our issue dated Feb-ruary, 1941

 The contest is open to all residents
- of the Western Hemisphere who are not in the employ of Scientific American
- 13 In fairness to all contestants, fail-ure to comply with any of the above rules will result in auto-matic disqualification

THE PRIZES

tion Model. Solid Gold, Men's Wrist Photo Enlargers (List Price \$42.50). Watches.

sentation Model, Solid Gold, Men's \$19,75). Wrist Watches.

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5th. Three PIERCE CHRONOGRAPH 2nd. Three \$85 LONGINES. Pre- Men's Wrist Watches (List Price

6th. Three BERMAN-MEYERS Flash 3rd. Three FEDERAL No. 246 Guns complete with case (List

7th. Three FINK-ROSELIEVE Vanorators (List price \$12.50)

HONORABLE MENTION 1st. Three Fink-Roselieve "Hi-Spot"

Hollywood type spotlights. 2nd. Three Mimosa Perkino devel- 5th. Three Fink-Roselieve Satinoping tanks.

3rd. Three Raygram Wood-Chrome Tripods. 4th. Three Fink-Roselieve Audible

Timers. Chrome Range Finders.

THREE SPECIAL AWARDS !

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price \$24.) 2nd. One No. 650 Weston Exposure Meter (List price \$19.95.) 3rd. One No. 850 Weston Exposure Meter (List price \$15.50.)

THE JUDGES:

McClelland Barclay, artist T J Maloney, editor of U. 8 Camera Ivan Dmitri, artist and photographer Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street

the extremes of brightness in a subject and then setting the *U* instead of the "normal" arrow, or the *O*, depending on which end of the subject brightness range is to be favored. a reasonably correct exposure will be obtained that will take advantage of the full scale of the film

A last word You may follow these suggestions and still go wrong However, before you start blaming the meter, ask yourself the following questions

- 1 Am I using the correct speed rating for the film?
- Is the shutter working properly? 3 Was the resulting negative coirectly developed?

Behind the Speedguns

THERE is much more to a Speedgun than may appear on the surface, as a visit to the Speedgun Corporation's plant in Bloomfield New Jersey, has convinced us For one thing more than 600 separate parts are required for the assembly of the vari-ous Speedgun models. To produce these, the Speedgun engineers employ 150 special tools one of which is a tube-cutting machine that not only saves several hurring operations in cutting dural and brass tubing, but is capable of slicing two-inch tubing to lengths as short as 10/1000 of an inch The Speedgun engineers design and make their own tools in many instances, thus making the plant independent of outside sources of supply

The development division of the plant, under the supervision of Philip K McGall, inventor of the Microswitch, is carrying on the work begun ten years ago by S Mendelsohn, of the Speedgun Corporation, in developing new techniques in synchronization design Many of the models turned out by this division are never seen by the general public, but the facts learned are incorporated in the design finally chosen for inclusion in the finished commercial product. The research is pursued not only for the sake of perfecting designs for current requirements, but also to keep a weather eye out for future needs and developments

One of the items that will see the light of day in the near future is the Multiflector, a reflector-magazine holding six No 5 G E "Mighty Midget" bulbs, these are mounted on the gun in the usual way and the lamps flashed either individually or in unison, depending on the number of switches thrown A special carrying case holding six of these Multiflectors will be available, thus making it possible for the photographer to load 36 bulbs at once and never handle a single bulb until they have all been flashed "On the fire" is another gun to be known as the Superspeed, which will fire 12 flashbulbs one after the other and which can be operated either on or off the camera

For accurate testing of shutter synchronization, a Speedgun Timer has been made available to newspaper offices and will soon be ready in sufficient quantity to be placed in centrally located agencies throughout the country The tester works at 1/10,000 of a second and permits ready testing with every assurance of certainty as to the result

Portraits With A Spectacle Lens

GET your optician friend to make you up a spectacle lens of a focal length your camera will accommodate, mount it in a square of cardboard of the right dimensions to fit the front of your camera, and try your hand at soft-focus portraits. The results may surprise you. The illustration is an example. Notice how the highlights spread out into the sha-



With a spectacle lens

dows and a general softness of outline prevails over the entire face Sharp pictures are not always the best pictures, particularly in the case of portraits, a soft picture such as this may often be superior

Fine-Grain Developer Formula

A FINE-GRAIN formula that appeared in the older issues of the "Gevaert Formula Book" is reprinted in the current issue or the Gengert Sensityzer It consists of only metal and sodium sulfite made up as follows Metol 1/4 ounce

Sodium sulfite-(anhydrous) 316 ounces Water to make 32 ounces Development is for 20 minutes at 65 degrees Distilled water is recom-mended The developer is said to keep a very long time

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Name.



--- CAMERA ANGLES-

nounced as "a national publication for amature photographers," it is published every Saturday under the editorish pot Don Bennett. The publication states that it "welcomes news of the activities of camera clubs and individuals and manufacturers interested in amature photography," and asks that in submitting copy having a time clement, the contributor should allow for the lapse of one week's time. The proposition of the proposit

Labels on Bottles

ONE of the most vexing darkroom problems is how to make labels stick on bottles. If some way were found to prevent sloshing water or other liquids over the label, there would be little trouble, but as this usually appears to be unavoidable, it it necessary to provide a means of protecting the label under all circumstances A suggestion is offered by Morris Germain, A.R.P.S., that he claims has worked for him for a long time He takes a few sheets of undeveloped glossy printing paper and, by the ordinary darkroom printing safelight, immerses it in the regular fixing bath. After the paper has been "fixed out," he turns on the white light, washes the paper in the usual way and then allows it to dry on a ferrotype tin He then cuts the paper up into the sizes he needs and letters the paper with black waterproof ink When the ink has dried thoroughly he wets the paper again, squeegees out the excess water, applies ordinary library paste on the back and attaches it to the bottle. The last operation is a coating of spar varnish

New Reflex Case

A sole leather, velvet-lined carrying case for the new Brownie Reflex Camera is being offered by United Camera Exchange of New York City

The case follows the styling and design of similar cases made for more expensive cameras of the candid type, and features a drop front allowing full freedom for the finder and taking lens, it also has a die-cut window in the reas so that film exposure numbers can be seen as the film is wound part of the Browne Reflex is used as the carrying strip.

For Nature Shooters

CHOOTING insects and other small creatures frequently offers obstacles because they cannot be kept in one place long enough for the necessary critical focusing (close-up lenses being required) and relatively long exposures. One worker got out of the bottle and then injecting into the bottle as mall quantity of illuminating gas from the kitchen gas jet. The creatures become dulled and as a recreatures become dulled and as a re-

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sult move very slowly. It is a simple matter then for the photographer-naturalist to place the insect where he pleases and to take his time about focusing and shooting. For the information of the tender-hearted, the effect is temporary and after the gas wears off the insect moves normally again.

WHAT'S NEW

In Photographic Equipment

MOORE "LONG FELLOW" ENLARGER (\$50 without lens) Features coolness, compactness, versatility Both enlarger and baseboard mounted on 90-inch chromium plated tubular upright. When not in use, enlarger and baseboard may be swiveled against wall Suction ventilation of lamphouse, aided by insulation of lower condenser from body of lamphouse, results in negative being absolutely cool There is no material rise in temperature, even if negative is left in enlarger for period of several hours without any air circulation other than that provided by enlarger itself Enlarger employs metal sleeve bellows Equipped with three lens boards, recessed, flat, and protruding to take all normal focal length lenses up to and including 6-inch Employs double condenser system, 41/2-inch condensers removable for cleaning Position of light bulb adjustable Equipped with plastic light filter for use when Focusing by focusing on paper Focusing by micrometer gear Will take negatives 35mm to 2¼ by 3¼ inches and any 214 by 314-inch portions of negatives up to 11 by 14 inches Wooden baseboard, crack - proof, warp - proof measuring 20 by 30 inches, may be rotated through 360 degrees, vertically or horizontally, allowing for any desired distortion or correction brackets furnished with 90-inch upright for attaching to side wall or floor and ceiling Regular table model also available called "Short Fellow" (\$40 without lens)

BROWNIE REFLEX (\$5.25) Miniature twin-lens reflex camera for be-Large, brilliant, efficiently ginner hooded reflex view finder, image remains visible during exposure Takes 12 pictures 1% inches square on No. 127 roll Size of camera 4% inches high, 31/3 inches wide, 21/4 inches through Compact design without projecting fittings Automatic selfcocking shutter with bulb and instantaneous settings, and plunger-type release Lens good quality meniscus of correct speed for daylight snapshots, as well as snapshots at night with high-speed film and Photoflood set-up. Fixed focus.

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THE BOUND TABLE

Questions Answered for the Amateur Photographer

Q I am planning to make an enlarger My largest size negative will be 2¹, by 3¹₂ inches. In consulting a table I find a 42y-inch focal length lens requires a distance of 6½ inches from negative to lens for a two-times enlargement. Could I use a single extension camera (4²-inche focal period of the camera (4²-inche focal of the camera of the focal of the camera—C.R. W.

A The arrangement you suggest sounds practical enough because you will have sufficient leavay in your bellows for the necessary adjustment. It is important of or magnitude to you construct this singly over the back of the camera and permits no light to escape around the connecting edges.

Q Where or from whom could I get specifications on the many lenses that are on the market for the miniature enthusiast to choose from? Details I want to get include the type class of the lens, good characteristics of the lens, good characteristics, and the lens, good characteristics, method of focusing, size of plate covered at full and at reduced aperture, and so on. Such a jumble of names (Ektar, Citar, Trolar, Trior, Elmar, Hektor, Zenor, Hypar, Dagor, etc.) means so little to me.—W. L.

A. Some of your questions are answered in scattered sources, but we

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-CAMERA ANGLES-

do not know of any one complete reference where information such as you want may be obtained However, the individual manufacturers or distributors are always glad to supply such information on request. Their addresses can be obtained from magazine advertisements or from your regular photographic dealer

Q Enclosed are a couple of vestpocket size negatives and a couple of commercial prints I know the composition isn't so hot and the lighting is terrible, so don't bother to card me out about that. However, a strong magnifier on the negatives shows a lot of detail that does not show up in the prints. Now the question. Could an old bird like me (fiddling with cameras for forty-odd years) do any better if he got a hundred dollars' worth of equipment and spent his spare time in the cellar? Is there any likelihood of better results if I were to do the work myself instead of sending them to a finishing plant?-H. A H.

A That depends on the plant to which you send your films. Some of them are first rate. In general, however, you could probably do much better in many instances because you would be able to give the work more time. The negatives you enclose seem rather contrasty and should have been developed in a soft-working developer because of the contrasty lighting employed You would know this and would be willing to use the proper developer for the type of exposures made. This is one great advantage of doing the work yourself. As for the prints, a softer paper might have helped matters some. In general, it is far better that the serious worker do the processing himself. The results will be more satisfying because the worker will be able to give each print the care and attention that the average finishing plant does not have the time for, the prices they get would not justify the effort

Q I have a Contax III with a f/15 lens. Can I use it in an enlarger of the Kodak type?-Dr. H. D.

We do not know which of the Kodak miniature enlargers you have reference to, but, provided it will accommodate a 2-inch lens, you should be able to adapt it to the enlarger Of course, a special lens flange will be required

O I have a 214 x 314 Speed Graphic and I use an Abbey battery case and reflector for the built-in focal plane synchronizer, with Press 40,000 flash bulbs. I shoot at 1/225 at f/8 and the exposures are perfect, but when I drop the exposure down to around 1/100 the density begins to fall off at the bottom of the negative .-- M. K.

The Press 40,000 bulbs should not be used with shutter speeds slower than 1/200th second, according to the advice of the manufacturers This speed-or greater-permits the focal plane shutter to traverse the film while the light is at its peak.



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It's Called "Targo"

Some will nick-name it "back-yard skeet." some may call it " vestnocket trap," but the Mossbergs have termed their latest innovation "Targo." and all who try it will sing its praises from the standpoint of good gun fun and excellent wing shooting practice The best part of the story is that, following their principle of providing shooting enjoyment for more people through good equipment at moderate



Loading

Cocking

prices, O F Mossberg & Sons, Inc. have arranged to offer their new combination gun-and-trap, together with miniature pigeons to be used with 22 caliber long-rifle scatter shot shells for indulging in the sport of "Targo" at so nominal a figure as to make the game available to all For less than \$25 you can own the gun, the trap, and even a net to save undusted pigeons from breakage when they hit the ground Your operating costs will be equally low, for the 22-caliber shot shells can be had for 50 to 60 cents per box of 50 and the clay birds will

be much less than one cent apiece The Mossberg Model 42 TR "Targo" gun is in reality two guns in one, for each comes with what is known as a "Rifle Adapter Tube" This is a rifled section of 22 caliber barrel, 5 inches long, which replaces a length of "Targun smooth-bore barrel, and go" which, by an ingenious new method of rifling, converts the "Targo" gun into a 22 rifle which is claimed to be as accurate as though rifled throughout Furthermore, there is a 7-shell capacity clip in the forearm below the chamber which makes a bolt action repeater out of the gun, shooting any standard .22-caliber solid ammunition

"The Targo" gun is built on the Mossberg "Master" action, walnut finish stock with molded trigger guard

with finger grooves and molded buttplate It is 431/2 inches long, weighs about 514 pounds and balances nicely with or without the trap It has a 22-inch round, smooth-bore barrel. and when fitted with the 8-inch "Targo" tube equipped with a special choke ring to prevent the shot from balling and coming out as slugs, it gives a nice, even pattern
The "Targo Trap" weighs 14 ounces.

is attached to the barrel just ahead of the forearm, is easily removed and will fit almost any single barrel 22caliber smooth bore or 410 bore shotgun The trap cocks effortlessly, is released by the fore finger of the left hand while the gun is at either skeet or shoulder position. The swing of the trap as it throws the "bird" is not sufficient to produce an appreciable sideways recoil in the gun To the contrary, the backward thrust is scarcely noticeable as the target sails through the air in any direction desired by the shooter, and it will be at once understandable that the variety of angle shots possible are almost legion An adjustment on the spring permits you to vary the flight of the targets, making the shooting easy or difficult, as you like

The "Targo" targets are ½ normal size, will break on impact of the tiny 22-caliber pellets up to 50 feet, and are packed in lots of 200 in special break-proof cartons developed by Mossberg When the Mossbergs say "break-proof," they mean it During a recent visit to the factory. Walter Pierson told us of some of the tests to which target-loaded cartons had been subjected They threw the packed cartons down the factory stairs, pushed them out the window, dumped them off fast moving trucks and generally kicked the poor things all over the lot. Even when they finally found a packing method which enabled the targets to survive such blitzkriegish treatment, they weren't



satisfied When you receive your first carton of "Targo" targets, you'll find a few extra for good measure and as a sort of "just-in-case" precaution Furthermore, five unbreakable targets, made of rubber, are a part of each "Targo" trap outfit These are used in distance and direction experiments with the trap, thereby saving a lot of clay pigeons

The "Targo" net, insurance against ground-smashed pigeons, is 20 feet square, is easily set up on 6-foot posts and has a mesh fine enough to catch



"Targo" birds and shells

and cave undusted binds but large enough and sufficiently flexible to permit the netted targets to be drawn through the net from below. With or without the net, "Targo" is a new sport to be enjoyed just about any place, including an open field, the golf or gun club, or even a large back yard The 120 to 130 pellets of a scatter shot .22-caliber shell are very tiny and are unlikely to cause damage when properly used, but as it still takes only one pellet to ruin an eye, don't forget the tried and true Commandment of Safety, "Never point a gun at anything you do not want to shoot." Allin-all, we believe "Targo" has unlimited possibilities for fun and help-ful firearms practice Want a "Targo"

Clean Barrels Shoot Better

It's a strange indictment against the gunning fraternity that about 98 percent of the enormous annual repair bill for guns is traceable to the owner's neglect. The introduction of noncorrosive ammunition led not a few to the belief that, save for an occasional natch and oil the barrel cleaning chore was a thing of the past True, non-corrosive shells will not rust the tubes. but they are primarily intended to knock over game or skeet targets, not to prevent rust. Likewise, the little problem of leading is still with us, and for some reason scattergun owners seem more prone than riflemen to rely only on oils, greases, and rags to remove lead, perhaps on the theory that the new powders fired through a clean bore with no rifling eliminate the necessity of this operation

In view of the extensive array of shotgun cleaning agents available, all at a very nominal cost, there is really no reason why shotgun barrels should not receive the best of care with the result that patterns will be improved, kills will be cleaner, and the gun will last longer As every gunner knows, lead in barrels retards and mutilates the pellets, causing them to sheer away from their normal flight and ruin

an otherwise effective pattern Not long ago we mentioned a new shotgun cleaning device known as the "Ferret Cleaner," and we have since observed that it has met with widespread approval from scattergun men Like other tube-scouring implements the Ferret is designed to remove lead deposits, and not to be used to the exclusion of a good oil, or grease, and a rag But, unlike the old style wire bristles, the Ferret "shaves" the lead from the barrels instead of brushing it off, often a not too effective process Composed of flat, bronze alloy wire. soft enough to prevent gun barrel injury yet hard enough to get at the lead. the Ferret is tapered at both ends to permit passing through the choke in both directions, either on the cleaning rod or on a stout cord It is selfsharpening and works even better after having been used a few times As the coiled, flat wires are formed into a tapered, cylindrical shape, it is unnecessary to impart a revolving or rotating motion to the rod when running it through the barrel

A recent letter from T R Walker of The Dairy Specialties, Inc., manu-facturers of the Ferret, stated "Since we have been making Ferret cleaners we have been surprised to find that many men who have used guns for years do not realize that they have lead in their gun barrels. When they clean their guns with a wire brush and patches, they polish up the lead until the gun looks clean Then, when a Ferret is run through, and they see the amount of lead which is removed by the bronze wires, they are unable to believe their eyes" All we can add is that we continue to use a good grade of oil for cleaning and lubricating, that we "Ferret our guns" religiously after shooting and that we believe the combination provides good insurance for longer lasting firearms and few, if any repair bills resulting from neglect of our guns

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E'vr often wondered why some-one didn't make a creel of aluminum, and now along comes Messrs. Smith & Focht with their "Ideal Creel," which appears to us to be very well named, indeed. Weighing but a few ounces more than our old reed

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a ring (Figure 2), carries a lens on the sunward side. and on the other an analemma, the familiar 8shaped curve of the equation of time By turning a thumbnut with the fingers, until the Sun's image falls exactly on the analemma, hands taken from an ordinary clock are mechanically actuated through gear trains and the standard time is read on the clock dial-direct and not by a shadow, as in a sun-dial There is, of course, no running clock movement

Working from the articles by Porter, cited above, Fred Ferson, 414 Reynoir Street, Biloxi, Mississippi,

has made the sun-clock shown in Figure 3, and states that "careful control of the sun such in one muntle, likewise the date The base casting has four leveling screws and carriers a second casting which supports in a curved slot a short, stubby curved main standing arm. This can be slid circularly and clamped for latitude At the end of this stubby arm is a rigid, hollow stud carrying the gear



Figure 3. Ferson's sun-clock

box and clock face and big, curved, rotatable fork. The fork has in its upper horn a slot in which is mounted a little lens of 8" fl The analemma is inscribed on a sheet biass plate bent to a radius equal to the fl of the lens (its radius of curvature is therefore nearly twice that of the forkstudy Figure 7 if "nearly" is not at first clear) and attached to the lower horn. To find the time at any desired moment the large thumbnut extending, in Figure 3, below and to the left of the gear box is turned with the fingers, and gears with ratio 1, 2, and 24 do the rest, that is, 24 revolutions of the handwheel will rotate the minute hand 24 times, the hour hand twice, and the fork once When the Sun's image is made to bisect the analemma curve the clock hands will automatically point to the hour and minute, also giving the date" Forson will lend further details of construction to those seriously interested

Even now, more than a decade after he made his first sun-clock (Figure 2). Porter still composes new variations on the original theme and then makes the clocks. Figure 4 is one of these, "It consists," he writes, "First, of a spherical Pyrex flask carrying all the optical parts and the clock face, on which is also engraved the analemma The entire unit is encircled by a grooved equatorial ring sliding on a segment below, which is fastened to was a 32-pitch rack bent to fit the groove of the equatorial ring

"In adjusting the polar axis paralle to that of the Earth, a tubeless telescope, consisting of an eyeplece and objective, is fastend to the sphere at the poles of the encircling equatorial ring. The field of view of the eyeplece contains just the apparent to the eyeplece contains the eyeplece of the sound of the eyeplece of Polaris by the stars in the Big Dipper and Cassiopeia, and using the base

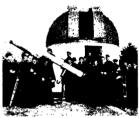


Figure 1 Astronomy class, St. Mary's

study serves a definitely practical purpose, since most of the seminarians will one day labor in foreign mission fields, where astronomical knowledge will supply in many ways what these primitive countries do not—aids in regard to time, in regard to nautical determinations, in surveying, and in exploration, to mention but a few

"A few years ago an observatory (Figure 1) was built at Techny, housing a 110 mm refractor, a cometseeker, the structure having been designed and constructed by the Brother Monks But this telescope soon proved inadequate for the interest and enthusiasm of the star-gazers, and it was deemed advisable to construct a larger one, 8" in aperture, the work being done under the direction of Father Francis Neuhaus, S V D, one of the seminarians Meanwhile, Brother Corsinus, S. V. D., an able mechanic, was busy constructing a well-balanced mounting, shown in the center With a surprising minimum of cost, the reflector was completed, and now serves to great advantage, not only to bring more of the heavens within grasp, so to say, of the students of astronomy. but also to render celestial photography possible because of the new telescope's greater light - gathering

"Work on a 12½" mirror for a still larger telescope is now under way"

MATEUR telescopticians, ten or twenty thousands of them, have now felt their way into about all the related arteries and capillaries of optics and astronomy. One such rami-



Figure 2: Porter, sun-clock

TELESCOPTICS-

screws, the polar axis of the instrument can be directly fixed.

"I find that the time can be relied on well within one minute. The glass flask was resorted to in order to protect all essential parts from the birds. who seemed to feel that I had made a gadget for their special benefit The neck of the flask and a part of the sphere were removed with a 'biscut cutter' (simply a cylinder of sheet metal) and abrasive The plate of the clock, having nearly twice the radius of the sphere, was spun to its required curvature All the machining was done on a wood-working lathe and drill press in the pattern shop here at The California Institute of Technology Figure 5 is a photograph of another spherical globe sun-clock made earlier and partly similar

And still another! Some months after the above descriptions were received, there arrived from Porter a note (Figure 6) and the following description "The clock to be described is about my tenth design and its performance has been so satisfactory that

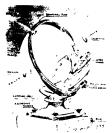


Figure 4: The bird fooler clock

I have decided to call it quits and turn the information over to those who may wish to have a gadget in their gardens demonstrating an interesting problem in celestial mechanics

"The drawing (Figure 7) is a meridian section through the instrument and for economy of space I have inserted, or superposed, the clock face in the central area, but its true position is shown in Figure 8 "A is a 12-liter Pyrex flask (Corn-

ing Glass Works-it cost \$3 50), whose neck B has been removed with a biscuit cutter The flask is remarkably spherical. "To this sphere are attached the

lens C and the brass strip D on which is pasted the analemma "In the space removed by the bis-

cuit cutter is the clock dial E. carrying a minute hand Behind the clock face is a reduction gear box operated by the thumbnut F Only two pairs of stock, 32-pitch spur gears (Boston Gear Works, Cat. No. 1-G 159, 161, 177, 179) are necessary to make the minute hand revolve 24 times during

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TELESCOPTICS.

one revolution of the sphere. This clock and the gear case are fixed rigidly to the base ring H, supported on three adjusting screws I, I, I, 120° apart, and these screws rest in a circular groove cut into the plate J which, in turn, is securely fastened to the pier.

"The polar axis L of the instrument is created and maintained by the glass sphere resting in ring H and revolving around the stud M by means of a pin N engaging a slot in the sphere To save an extra pair of gears for the hour hand, this pin N serves equally well to indicate the hour. The stud M has an inclination to ring H (horizon) equal to the latitude of the location. shown here as 40°.

"In operation, by turning the thumbnut, the sphere is rotated until the Sun's image falls on (and bisects) the analemma, and standard watch time is taken directly from the clock face A small portion of the analemma is shown at O, with the Sun's image as it would fall on the 15th of May, the portion opposite covering July and



Figure 5: Another similar type

August Should the image be made to fall on the center line at P, the clock would read apparent or sun time But PO happens to be the equation of time, so that, by using the analemma, standard time is obtained automatically Furthermore, any deviation of the observer's position east or west of the central line of the time zone in which he resides is corrected by resetting the minute hand This is, of course, a constant.

"The analemma is marked off in five-day intervals, so that the day of the year is given, as well as the hour and minute. It is easily drawn from data in the nautical almanac

"I have found that the best illumination of the Sun's image is produced by an f/80-or-90 lens. In the clock here described the focal length is 10" and the lens 1/8" in diameter.

"Adjusting is done with a small temporary telescope, as previously mentioned By using the three adjusting screws I, Polaris may be brought to the required hour angle (see Q in upper, left hand corner) The telescope is removed (next day) and replaced by the sphere and clock unit.



Figure 6: An addict's confession

"Finally, so that the instrument may be removed and taken indoors at any time and replaced without disturbing its alinement, a positioning stop R is provided, which is simply a strip screwed to J and against which the south adjusting screw rests "

The above description of a sunclock, by Porter, is more detailed than those in the earlier, 1928 and 1935, articles referred to farther back, hence the would-be maker will not gain by hunting them up An enlarged photostat of Figure 7 is available, for a

small sum, from the editor Builders of such things as sunclocks will occasionally hear this objection "What real, practical good or use is the thing, when we all own watches?" To a man having that type of mind a sun-clock is no good at all, and one suggested answer is simply, "None" This should stall him, completely To other types, however, such a thing is not only a pretty thing to own, but it visibly and tangibly demonstrates our precise knowledge of the Earth's motions in space, and thus the value is mainly intellectual

this nation is dragged into a war, facts stated by Carl L Bausch, of the Bausch and Lomb Optical Co., Rochester, N Y, in an article on "Op-tics and Defense," in the May-June, 1940, number of Army Ordnance (Mills Bldg, Washington, D C), may interest readers of this department

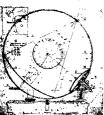


Figure 7: Porter's final (?) job

-TELESCOPTICS-

Mr Bausch states that "Bausch & Lomb is now making 24 types of optical glass The present monthly capacity is about 10,000 pounds per month . Practically all materials now used in glass making come from domestic sources, with the exception of nitrates which come from Chile in their crude form and are purified here. The choke point in glass making is no longer the procurement of sufficient and suitable melting pots The bottleneck has been transferred from the manufacture of glass to the manufacture of optical parts and to the assembly and adjustment of the instruments We could increase the output of our instrument plant five times in dollars-and-cents value of product in the first three years of an emergency It would be necessary to work three 8-hour shifts or, preferably, two 10- or 12-hour shifts We would have to add 4000 more employees to our payroll During the recent years of depression, mechan-

ics have not been trained as they

were previously, and I think it is safe to say that the available supply of



Figure 8: The same as Figure 7

it was in 1917 Without skilled labor available, it will be necessary to recruit younger employees into our organizations to increase production, as young woikers learn a new job much faster than mature ones

These (the 4000 new employees) will be divided as follows Glass plant 200, optical parts work 1000, manufacture of mechanical parts 1000, assembling and adjusting 1500, toolmakers, etc, 300."

Asked whether amateur opticians, such as read the present pages, could be used, Mr. Bausch replied "We al-ready have a couple men in our precision optics division who came through the amateur telescope makers' channel. We believe, everything less being equal, that a man who has had experience in making reflectors for his own use will be more valuable to us as an opticiant han one who has not had a try at it."

On to Rochester, you am-optical patriots—in case Uncle Sam fights!

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A Reminder

MPORTANT changes in the Patent Law become effective on August 5. 1940 After that date an application for a patent cannot be filed more than one year after the invention has been made public either by being described in a printed publication or by being publicly used or sold Prior to this change applications for patents could be filed within two years after an invention has been made public Another change in the law, forming a corollary to the above change, provides that claims cannot be copied from issued patents for interference purposes more than one year after the granting of the patent

Loop Hole

The Federal Trade Commission is not empowered to restrain unfair methods of competition or unfair and deceptive practices in intra-state commerce, even though the unfair practices adversely affect interstate commerce, according to a recent decision of a Federal Circuit Court of Appeals

The Commission had instituted proceedings against a candy manufacturer charging him with using or promoting a lottery in connection with the sale of its candy. The manufacturer sold assortments of candy to dealers. In each assortment there were candies having differently colored centers and the purchaser of these candies was entitled to receive.

free of charge, a larger piece of candy In a prior case the United States Supreme Court had sustained the contention of the Commission that the sale of candy assortments of this type constitute an unfair method of competition and upheld the power of the Commission to restrain such sales in interstate commerce. In the present case the manufacturer confined his sales of the candy assortments to the Under the circumstances the unfair method of competition did not take blace in interstate commerce.

The Commission proved that the candy assortments were sold in competition with the product of other manufacturers who were engaged in interstate commerce and it was contended that the unfair method of competition in question adversely affected interstate commerce The Commission argued that it was empowered to protect the interstate commerce of the competing manufacturers by restraining the unfair

methods of competition of the manufacturer proceeded against, even though these methods were employed solely in intra-state commerce.

The Court fully considered the contention of the Commissioner and did not deny that the unfair methods of competition adversely affected interstate commerce. It concluded, however, that the powers of the Commission were limited by the Federal Trade Commission Act to restraining unfair practices in interstate commerce. In this connection the Court

stated
"The only practices with which the
Commission may concern itself are
transactions in interstate commerce
The Commission's authority is to be
found in the act which created it,
as amended The purpose of the act
was to supplement the Sherman
Anti-Trust Act, * * * and to prohibit
practices which were unfair and destructive of competition in interstate
commerce "

Doubtful

A PATENT interference is a pro-ceeding in the Patent Office to determine which of several contending parties is the first inventor and as such is entitled to receive a patent for the invention The usual interference involves two or more applications for patents. However, at times an interference involves a patent and one or more patent applications. When the interference is between applications for patents the burden of proof of the junior party-that is, the last party to file an application-is the same as in an ordinary civil suit and it is only necessary for the junior party to prove priority of invention by a preponderance of evidence However when the interference is hetween an issued patent and a patent application filed subsequent to the issuance of the patent, the burden of proof of the junior party is the same as in a criminal case-namely, the junior party must prove priority of invention beyond all reasonable invention doubt

Gould
The importance of this distinction
is illustrated by a recent interference
involving a patent and a patent appircation The proof of the jumor
party in the interference in question
party in the interference in question
testimony and upon certain drawings.
The drawings contained additions and
changes and the witnesses were unable to state exactly when the additions and changes were made The
Court stated that the witnesses were

__ LEGAL HIGH-LIGHTS___

unquestionably men of good character but pointed out that there were certain weaknesses in the evidencenamely, the original model or device embodying the invention could not be found and was not produced and the drawings relied on admittedly included changes and additions Under the circumstances, the Court concluded that there was at least a reasonable doubt that the junior party was the first inventor and on this basis awarded priority of invention to the owner of the patent In reaching itdecision the Court made the interesting comment that if the junior party were only required to prove his case by a preponderance of evidence then they would be justified in deciding in favor of the junior party

Pomer Rolls

A PATENT for an improved press was held to be valid and infringed in a recent suit in the federal courts The patent related to a press roll made of crushed or ground stone held in a binder of vulcanized rubber Prior to the patent, press rolls in papermaking machines were made of iron, wood, various alloys such as brass, and also granite The Court found that each of the materials previously employed in press rolls gave rise to difficulties Thus the granite was too heavy, the brass would score and damage the paper, and the wood would rack

The Court found that the patented to oll solved the problems presented by the rolls previously used and concluded that the patent was valid. In an attempt to invalidate the patent the infringer cited certain earlier patents relating to rolls used in fruit presses and clothes wringers. The Court refused to consider these patents on the grounds that they related to a remote and non-analagous art.

Unprotected Panties

I'v a case of human interest—but one which will certainly not affect the destinies of the world-a Federal Court held that a copyright cannot be obtained for a pair of rubber panties Suit was brought for infringement of a copyright relating to a folded greeting card containing the representation of a traveling bag on the outside and a pair of rubber panties pasted on the inside. The defendant's card differed from the copyrighted card in details but was similar in essentials. The Court found that there was nothing new in the representation of a bag on the outside of the card and that this feature was not protected by the copyright. The Court also held that there was nothing "of literary or artistic production in the pants, any more than in a cigar or a safety pin attached to a card" and concluded from this that the panties were not subject to copyright protection under our laws

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VENETAN BLIND MANUAL is a 24-page illustrated catalog that presents specifications, standards, and design data on venetian blinds and their installation It deals with both wood and metal blinds. Chicago Venetian Blind Company, Michigan at 39th Street, Chicago, Illinois—Gratis.

Photoelectric Analytical Methods is a 24-page bulletin which contains abstracts of a large number of recently published technical descriptions. The exact details are given for the applications of these methods

with one particular type of Photometer. Wilkins-Anderson Company, 111 North Canal Street, Chicago, Illinois.—Gratis.

How no Cur Costs and Incerase Paortrs is a saw manial edited for those whose work involves production processes which necessitate the use of saws. It is specifically concerned with the "Speedmatic" saw for use in building, shipping, maintenance, manifacturing, and so on This saw is a high-speed, power-driven, but hand-guided, portable device Porter-Cable Machine Comput, Syracues, New York—Gratis

PATTERSON PERSIL AND BALL MILLS is a 32-page illustrated catalog of high-grade machines for use in the fine-grinding field. A large number of types are illustrated and described and their uses are dealt with briefly but clearly Patterson Foundry and Machine Company, East Liverpool Ohno—Grats.

Roansier Devictorment is a 64-page typewritten report of the Joint Committee of the Highway Research Board and American Association of State Highway Officials It deals largely with the work which is being done to beautify highways in the both functionally and in relation to adjacent land use It takes up such matters as zoning of roadside businesses, the limited use of roadside signs, and so on Iriphway Research Board, Duisuno of Engineering and Industrial Research, National Reference, National Research, National Research

UTILO FILTERS AND COMBINATION LESS SHADES IS a 14-page booklet devoted to a description of American-made optical glass color filters, supplementary lenses and combination lens shades In addition, the booklet provides a comprehensive guide to the use of filters and supplementary close-up lenses under various conditions. Filter factors are given for form of the color and black and white Photo Utilities, Inc. 10 West 33rd St, New York, New York—10 cents

RAILWAY LITERATURE FOR YOUNG PROPER is a bibliography of books and periodicals that is designed to answer many inquiries which are received by American railroads regarding varque phases of operation Association of American Railroads, Transportation Building, Washington, D. C.—Gratis

THE GLUE LAMINATED WOODEN ARCH is a 124-page illustrated booklet that deals specifically with this particular type of construction, citing advantages and disadvantages and showing many of the functional applications Technical Bulletin No. 691, U. S. Department of Agriculture, For sole by the Superintendent of Documents, Washington, D. C.—20 cents (coin).



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CIENTIFIC AMERICAN

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Our Book Corner

Legal High-Lights

Current Bulletin Briefs

50 Years Ago in . . .



(Condensed From Issues of September, 1890)

EIGHT-HOUR DAY—"The House of Representatives has recently passed a bill ordaining that eight hours shall be considered a day's work for all laborers, workmen, and mechanics, now or hereafter to be employed by the government"

MONEY—"Congress ought to issue a sufficient amount of fractional paper currency to facilitate exchange through the medium of the United States mail. The people found it useful, and it never ought to have been abolished."

SINKING WOOD.—There are 413 species of trees to be found within the limits of the United States and Territories, 16 of which, when perfectly seasoned, will sink in water All the species heavier than water belong to tropical Florida or in the arid West or Southwest."

MACHINES AND LABOR—"The successful introduction of typesetting machines into a number of newspapes offices in the United States has greatly stimulated their competitors, and early in the autium, the New York Sun, Times, World, and other papers will commence their use It is also said that the Herald will employ them A member of New York Typographical Union No. 6 says: "Of course, some members of the Union are a little skeptical as to the benefit these machines will be to the followers of the craft, but the whole history of labor-saving machinery teaches us that nothing has yet been invented that has lessented the need of good workmen."

COMPOSITIONS—"A new mode of treating hemp, jute, and other fibers for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a recent patent specification"

WATER FOWER—"Cataract Construction Company has secured a large area of land (several square miles) on the Nagara River, beginning a mile and a half above the falls, and all rights of way for carrying a timnel under Nagara Village to a point below the falls. The general plan is to construct a timnel about 27 feet in diameter from a proper by This timnel will have lateral bis inches at a depth of about 100 feet from the surface, anto which will be sunk numerous vertical shafts at the points where power will be required. A system of surface canals will bring the water of the river to the heads of these shafts, and its action on turbines at the lower ends of the shafts will develop about 150,000 horse power. The amount of water per cent of that some over the falls."

BROKEN NECK.—"Physicians connected with the Presbyterian Hespital are highly elated over the fact of their having successfully mended a broken neck. The patient, aged fourteen years, fell from an elevator, landing on his head and dislocating his neck. When brought to the hospital the case was considered hopeless, but by experiments with extending weights attached to the patient's head and feet the neck was eventually set and kept in place by and feet the neck was eventually set and kept in place by the property set and the patient has full power of the neck." STEAM TRACTOR—"Among the latest machines designed for use on large fairms is the new field locomotive of Jacob Price, of Racine, Wisconsin, illustrated herewith It is said that this machine pulled, near San Leandro, an outfit of twelve 11-inch plows in a dry, adobe soil, traveling at the rate of over four miles per hour in doing so, and maintaining the steam pressure at 130 pounds, without difficulty It will pull as much as 40 or 50 horses, besides propelling itself. Its weight is only 81½ tons. The carrying wheels are about 8 feet high and 26 inches wide. The steering wheel is 5 feet high and 14 inches wide. It is adapted for plowing, running combined harvesters,



freighting with wagons, hauling saw logs, or pulling of almost any kind, and is suitable for any stationary work, such as running thrashing machines, sawmills, etc."

SPEED AFLOAT—"The torpedo boat Adler, constructed in Germany for the Russina Black Sea fleet, is described by the Russian papers as the fastest war vessel afloat, having attained during its trait irp a speed of 26 55 knots. The boat is 150 feet long and 17 feet broad, with a displacement of 150 tons. Three guinbasts, one of which—the Narphen constructed in German shippards for the Baltic feet. The Baltic fleet will be almost as fast steamers as the Adler."

MUSIC FROM AFAR—"An interesting and really notable musical and vocal entertainment was given recently from New York to a very large audience assembled at the Grand Union Hotel, Saratoga, by means of a 'long distance' telephone circuit running a distance of 180 miles from 18 Cortlandt Street, New York, to Saratoga From Cortlandt Street a circuit had been run to the Madison Square Garden, and the concert being given by the Strauss orchestra was taken in alternation with the other numbers of the programme The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud-speaking receiver provided with a large funnel-shaped resonator to magnify the sound "

Personalities in Science

TRADITION has grown up in the life of David Burpee, internationally known plant hybridist and seedsman—a tradition centering around a 33-year search for a yellow sweet pea He hasn't found or produced it yet but, oddly enough, has given to the world other improved yellow flowers

Mr Burpee was born in Philadelpha, Pennsylvania, April 5, 1893 He was educated at Blight School, Philadelphia, Doylestown High School, Culver (Indiana) Military Academy, and the Agricultural College, Cornell University His father gave him the choice of Cambridge (England) or Cornell, and young David, who had traveled many times to Europe, paid a special visit to Cambridge before selecting Cornell

David Burpee started on his careet to achieve new flowers for American gardens as a youth of 14 and has contributed much to floriculture. He has been very successful in producing new strains, marigolds, and calendulas, but has not yet achieved that which started his deep interest in horticulture the production of a pure yellow sweet pea for which his father, founder of the W Atlee Burpee Company, offered him a greward of \$1000 To a young sechoolboy, this sum looked like stumendous wealth

At the Burpee seed farm at Lompoc. near Santa Barbara, California, young David and his brother, whom he had inveigled into joining the search, trudged up and down, row after row of the 400 acres of sweet peas hoping to find that Nature might have done the trick and turned up a yellow break No luck there, so he avidly read book after book on genetics and plant breeding, obtained seeds of over 150 species of the sweet pea family from all corners of the globe, grew them at his Fordhook Farm near Doylestown, Pennsylvania, and the following summer pollinated hundreds by hand - a back-breaking task Today, 33 years later, he is still trying to produce a yellow sweet pea

At 21, he was assistant to his father in their seed business and a



DAVID BURPEE

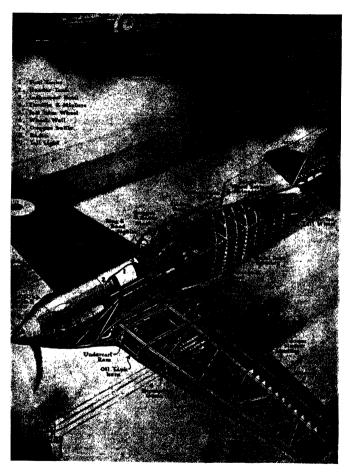
year later became General Manager Three years after first joining the company, he became President when it was incorporated in 1917 Among his other interests, he is Director of several banks and trust companies, has served as vice president and president of the American Seed Trade Association, is Vice President, National Sweet Pea Society of Great Britain, Honorary Life President of the Canadian Society of Philadelphia, director or trustee of several hospitals, horticultural societies, and the like, and is a member of prominent clubs

"Flowers have fashions just like clothes," Mr Burpes says "In the old days, gay blossoms forming a hodge-podge of color were the garden vogue but, today, we want color in mass whether it be soft pastel shades or vivid hues, and it is the production of these "fashion flowers' that keeps the hybridists and plant breeders busy"

David Burpee was the first to produce a big marigold with truly odorless foliage, the first double red hybrid marigold, and the first double nasturtiums in all colors

The first super-double nasturium, having 75 petals, was nother of Mr. Burpee's floral successes He purchased seed of the original Golden Gleam, grew them at the company's Floradale Farm, Lompoc, and crossed them with 40,000 other nasturtiums in the hope of producing a new flower Finally he was successful and the first seeds and cuttings—so heavy was the demand that the supply of seeds alone was inadequate—sold for 10¢ each which was an unheard of price for nasturtiums.

What a wast story of adventure, hard work, and disappointment hes behind each of Mr Burpee's floral achievements' His aim has always been to work with and produce fool-proof seeds that would grow in any garden rather than to experiment with rarer flowers with which the average gardener would be apt to have great difficulty.



A HAIL OF LEAD FIRE OVER ENGLAND

This British "Hurricane" fighter is a formidable opponent. Eight Browning guns mounted in the wings, are aimed by "aiming" the plane, and fire a total of 2400 rounds in 10 seconds. Speed of the plane is 340 miles per hour (recently increased 10 percent); ceiling is seven miles: and cruising range 600 miles.

COAL TAR BEGAN IT

Vast Increase in U. S. Organic Chemicals Industry

CHARLES M. HACKETT

In 1919, the Committee on Finance of the United States Senate weighed a serious question should the government "promote the establishment of the manufacture of coal tar products in the United States" Before the group appeared a distinguished witness, Dr Marston Tayloi Bogert, senior professor of the Department of Chemistry at Columbia University

Dr Bogert painted no rosy picture. He described organic chemical research in this country at that time as being "on a fragmentary basis" Further, he noted that such a development would have farreaching consequences in bolstering the national defense.

"Gentlemen," he testified, "I have no hestitation in saying that a well-developed synthetic dyestuffs industry is absolutely necessary for the security of our country."

In two decades the significance of that testimony has re-shaped the American industrial pattern.

Dr Bogert did not mean that America had no chemical industry As early as 1865, the value of chemicals produced in this country was about \$60,000,000. In 1910, the United States produced three times as much sulfuric acid as Germany. and twice the alkalies produced by England The value of chemical products in 1914 was quoted by the U S Census of Manufacturers as in excess of two billion dollars Satisfactory progress had been achieved in acids for the steel and fertilizer industries, and other socalled "heavy chemicals."

The noted professor's concern was caused by the fact that the World War, then just concluded, had disclosed a woeful lack of both the knowledge and manufacturing facilities required to produce many essential materials that could only be made by greater knowledge and

application of organic chemistry
The situation described by Professor Bogert led to an intensive
program of chemical research
which, in less than a quarter of a
century, has produced one of the



greatest organic chemical industries in the world, and which still seeks new knowledge and new ways of applying the products of this industry to the everyday lives of millions of people in this and other countries. Evidence of this continued search may be found in the report that the American chemical industry spent an estimated \$20,00,000 on research in 1937, alone. Only the steel and petroleum industries are said to provide for comparable expenditures.

Organic chemistry has synthesized the dyes, textile fibers, pharmaceuticals, flavors, perfumes, and scores of similar products which have caused some to designate the present as the Chemical Age

This industry is a substantially 100 percent American development American initiative has directed its course, the methods employed in building it up were American methods, and it has been financed by American capital. This does not mean that we have not profited from foreign developments and foreign experience. We have, and gratefully acknowledge it.

The organic chemical industry now ranks close to the top of American enterprise. It has promoted the growth of new industries and stimulated many older ones. It has brought the good things of life to more people, and it has bulwarked national self-sufficiency

No one alert to contemporary developments need be told of chemistry's importance. But the rate of growth is impressive to the most casual observer.

In 1914, we made only about 10 percent of the dyes we used, and even that small amount was based on imported intermediates. In 1938 we produced some 96 percent of the dyes consumed in this country, and had an export balance of more than five million pounds.

SINCE 1919, when organic chem-icals manufacture was in its infancy here, countless new products have been developed Of those known in 1919, U.S. production has increased steadily The average annual increase in flavors and perfumes between 1919 and 1937 was 29 percent, in photographic chemicals, 22 percent. Total coal tar finished products showed an average annual rise of 18 percent. In the 17-year period 1921-1937, production of non-coal tar organicsincluding synthetic methanol and other alcohols, acetic acids, acetone and various amines-showed an average annual growth of 685 per-

Americans past the age of 30 may grasp some idea of the significance of the above figures if they compage the increases with that of the automobile industry, whose products they have seen filling the streets with more and more cars year after year, and for which they have watched broad ribbons of highways built from coast to coast Yet the average annual increase in automobile production between 1919 and 1937 was but 9 6 percent. as compared with the spectacular rise in various organic chemicals That the rise has been less noticed may be accounted for by the fact that the products of chemistry, for the most part, remain hidden and do not add to traffic problems

With this accelerated production have come price declines as phenomenal as manufacturing increases. The average price of coal far products dropped between 1919 and 1937 from \$1.02 a pound to 41 cents, coal fair dves from \$1.07 to

these classifications have been made for many years, but in a larger sense they represent new industrial entities

Plastics of the nitrocellulose type have been known and employed since 1869 (Celluloid), but the modern plastics industry with its versatile performances could not operate without a plentfull supply



Plant where several well-known organic chemical products are made — du Pont plant at Deepwater, New Jersey. Note many buildings

55 cents Flavors and perfume chemicals fell from \$2.27 to \$1.02. Phthalic anhydride, used in the manufacture of alkyd resni finishes and certain dyes, is available today at 15 cents a pound, although it at 15 cents a pound, although it was around \$6.00 a pound in 1917. Production of this important industrial chemical during 1939 is estimated at 60,000,000 pounds

Certain inorganic chemicals used in making organic products have likewise enjoyed important price reductions. During the 1919-1937 period, sulfuric acid dropped in price about 31 percent, caustic soda nearly 45 percent.

These advances in production and reduction in prices have affected the lives of virtually every American, and have created a high degree of dependence upon organic chemicals. They pervade nearly every aspect of contemporary life, and fundamentally affect our national economy.

This development stretches into the nerve centers of the country's economic system. It has provided jobs directly for thousands of worker—how many thousands of worker—how many thousands additional employment avenues have been opened up by providing raw materials for many new industries. Dyestuffs, pharmaceuticals, and plastics provide conspicuous examples. Some products in

of organic chemicals Acetic acid, synthetic camphor, and phenol could be cited. Formaldehyde and urea, a gregarious pair useful either in harness or singly, are found in avariety of well-known plastics.

The industrial importance of camphor may be emphasized by its use in motion picture film, which demands more than a half-million pounds a year Camphor was contiolled by a Japanese monopoly only a few years ago, and under Japanese domination the price of refined natural camphor went to \$3.55 a pound in 1920

Tonay refined synthetic camphor is selling for about 80 cents a pound, while the technical grade used in plastics and photographic film sells for around 35 cents. American chemists have learned to make camphor from southern tirrentime. It is of high quality, chemically identical with the product long sacred to the fragrant forests of Formosa. The Du Pont Company is supplying more than half the total domestic consumition of this important material.

Imported urea cost about 57 cents a pound, corresponding to more than \$1100 a ton, in 1920 Now urea of equal or better quality derived from carbon dioxide and ammona sells at the plant for \$85 a ton—and a donestic source

furnishes practically every pound of urea consumed in this country.

New materials for making wholly new plastics have been found. The sparking "Lucite" methyl methacrylate plastic with its extraordinary toughness, beauty, and optical properties, is a notable example. In fact, the entire modern plastics industry is the precocious child of organic chemistry.

Still other organic chemicals, synthesized to meet definite specifications have likewise aided development of new industries The "Freon" fluorinated hydrocarbons afford an excellent illustration of such made-to-order products Not only is "Freon" an excellent refrigerant, but it is non-poisonous, non-explosive, and non-flammable This combination of properties lent great impetus to air-conditioning This new type of refrigerant is widely used today in the air-conditioning units of theaters, hotels, office buildings, and railroad trains

Of outstanding importance in the manufacture of rubber goods are the new and improved organic accelerators, anti-oxidants, sunchecking inhibitors, and agents which nullify the destructive influence of slight traces of copper The fact that today's automobile tities give some 25,000 miles of service in comparison with 5000 miles only a few years ago is due in no small degree to the use of such organic rubber chemicals.

Synthetic rubber-like materials developed within the past few years have been accorded a hearty welcome by fabricators of rubber goods Although different in composition from natural rubber, the physical properties of certain of these synthetic materials are similar to those of rubber At least one of these new materials-neoprene -has qualities not found in the natural product, including resistance to oils, greases, chemicals, sunlight, and oxygen It fills hundreds of needs that natural rubber cannot fill, and this chemical rubber is based on abundant domestic raw materials -- coal, limestone, and salt

Discussion of the role of organic products would be incomplete without reference to rayon. This country produced some 288,000,000 pounds of rayon in 1938, the more recently developed products such as "Vinyon" and the polyamides known as nylon open promising horizons.

The work that organic chemicals have performed in the automobile

industry has become classically familiar, although it often is not of thought of in terms of chemistry Nitrocellulose lacqueis, developed about 1921, represent one of the greatest contributions By cutting down finishing time with orthodox oneamels, durability had been sactified, but the nitrocellulose lacqueirs are both quick-drying and durable

The recent development of polyvinyl acetal plastics has a direct bearing on the automobile industry For many years safety glass for windows and windshields was made with an interliner of nitrocellulose or cellulose acetate plastic. but last year it was found that an interliner of a certain type of polyvinvl acetal plastic has definite advantages over the cellulose plastics. This new type of plastic is extremely tough and elastic not only at ordinary temperatures, but at low temperatures as well It is for this reason that the polyvinyl acetals-products of the organic chemical industry-make possible the safest safety glass ever made

Synthetic organic chemical, find numerous important applications in the manufacture and use of petroleum products. Cracking processes have had the effect of doubling national oil reserves as far as gasoline is concerned. On the other hand, cracked gasoline in storage has a tendency to develop gums which lead to clogging of motor and fuel lines. Certain organic chemicals, however, have substantially climinated this tendency.

In the manufacture of perfumes, materials known as "fixatives" are used. One of their functions is to make the odor more lasting. Until a few years ago, all fixatives were of animal origin, such as the musk from a species of deer in Tibet. The



Stills used in making synthetic camphor from CO, and ammonia

characteristic ingredient of natural musk, if it could be had in a perfectly pure state, would probably be worth its weight in gold several times over. Within recent years, however, synthetic musks have been developed, and at least one of these new organic compounds is substantially identical with the characteristic ingredient of natural musk. These sell at a fraction of

the cost of the natural product. To the enrichment of American haivests, the organic chemical industry has made many notable contributions. Use, a synthetic nitrogenous chemical, not only indisa application in plastics, but also as a fertilizer ingredient Organic mercurials are being used successfully for the control of various plant diseases caused by fungi, and the long-chain alkyl hodianates are combating the ravages of sucking insects on certain agricultural crops

Nowhere have organic chemicals played so vital a role as in the prevention and cure of disease

Not long ago a little girl was stricken with a much-dreaded streptococcus infection. Her terrified parents were astonished to see their physician view the danger calmily

"Now," he said, "we have a new weapon for such infections—sulfanilamide."

The little girl got well

Although introduced into the materia medica only a few years upo, this coal-tar derivative has already saved the lives of thousands suffering from "blood poisoning," pertontia, streptococcie sore throat, puerperal or childbirth fever, meningitis, and other dangerous maladies resulting from streptococcie infection.

Fundamental research in such alls which have sciences as chemistry, physics, science for ages



Packing synthetic camphor as

biology, and pharmacology are believed to hold the key to the great medical developments of tomorrow. Chemotherapy, itself fully as important as the first work of Pasteur's laboratory, is nurtured by the organic chemical industry. A long list of new organic compounds awais the attention of the research workers in pharmacology and experimental medicine. Pharmacological development will continue to be supported to an increasing degree because of the chemical manufacturing industry's growth

The research chemist has established the constitution of certain of the hormones. These little-understood secretions of the ductless glands in some degree affect the functioning of the mind as well as regulate the chemical reaction of the body. Some of these "chemical messengers" have now been synthesized in the laboratory. Developments in this field offer promise of cure for certain mental ills which have baffled medical science for ages.

Breath of Industry

Oxygen Torches Cut, Condition, and Prepare Steel; Drill Stone and Concrete

HAROLD LAWRENCE

THE air we breathe is being used in some mighty strange places. More particularly, the oxygen of the air supports many industries just as it supports us. Steel is being

conditioned with the aid of oxygen Steel plate edges are prepared for welding by this same gas Precise shapes are being cut with oxygen, replacing a multiplicity of machine tools Steel structures are prepared for painting with the oxy-acetylene de-scaling tool. And both concrete



Oxygen flame rapidly cleans steel surfaces for painting

and rock are being drilled in this

Most of the oxygen being used in these new industrial operations is separated from the air. Yet in some cases where there is an outlet for hydrogen, too, as in the packing industry, oxygen is obtained from water Whatever the source, the utmost in purity is demanded. The oxygen used for cutting must be every bit as pure as that used in hospitals, 995 percent or more pure If it takes 100 cubic feet of 99.5 percent pure oxygen to do a specific cutting job, it will take 160 cubic feet of 97 5 percent pure oxygen to do the same job And that's the very reason that causes engineers, cost accountants, and production men to watch the purity of

the oxygen with an eagle eye One of the most spectacular applications of oxygen has taken place in the steel industry Here, conditioning of blooms and billets has always been a costly and slow operation When steel is poured from the ladle into an ingot mold, some splashing occurs Such splashed steel sticks to the mold walls and leaves a scab on the rolled product Furthermore, cracks and laps and laminations as well as other surface defects may show up during the rolling of the steel So just before the final rolling operation, inspectors go over every inch of the steel surface looking for these defects, finding them, and marking them for removal There on the billet dock-where semifinished steel is inspected-the skin of the steel is given a beauty treat-

No doubt few of you have ever stood on the billet dock of a steel

mill listening to the roar of hundreds of chipping guns. The roar ebbs and flows and grows until you feel sure that your ear drums will burst If you have never heard this awe-inspiring sound, you never will The almost soundless hiss of a small stream of oxygen has silenced the roar forever Chipping guns have been scrapped. Men s nerves aren't jarred by bucking air-hammers all day long Steel conditioning costs are down Production speeds are up. And despite the tremendous quantities of oxygen being removed from it every day, the air still remains one-fifth oxygen

Perhaps one might think that the introduction of flame scarfing to replace slow chipping operations on the billet dock satisfied the steel men. No, the increased speed and lower costs made these men eager for more improvements. Out of the oxygen research laboratories they came No longer did the steel blooms and billets have to cool in endless rows and piles before getting their skin treated. Now the glowing steel thunders from the hot shears to a peculiar looking device whose many-fingered arms nestle into place A control is operated Hundreds of 1ets of oxygen open, bathing the unhealthy skin from the steel

THE octopus device draws back its bounces down the roll table to the reheating furnaces where it will be reheated for the final rolling operations Note that the steel can be charged into the reheating furnaces hot instead of cold, the heat locked up in the steel isn't wasted Thus fuel consumption per ton of steel produced was reduced a little more The process of removal of slight surface imperfections, known as steel conditioning, was modernized. Production no longer remained at the mercy of the snail-like conditioning operation Pure oxygen changed all that

But the steel industry is not the only industry to benefit from research into the industrial application of coxygen. When boiler and pressure vessel manufacturers progressed from riveted to welded construction, old-time boiler-makers hung up their riveting guns with a sign of relief. The ungodly clatter was over A good riddance, too. But along came construction codes such as that sponsored by the American Society for Mechanical Engineers demand-

ing the removal of the unwelded zones between the two sides of a weld, these zones being necessary to hold the molten metal temporarily

Down came the air-hammers This time they would be used to drive diamond-point chisels Back came the racket and the roar—the same unnerving noise that had made such a bediam of the steel billet dock But not for long

Oxygen men were not ready to ring down the curtain on another possible application of their equipment. So flame-gouging was born The same oxy-acetylene preheat flames backed up by a low-pressure stream of oxygen, delivered through a special nozzle, would do the work of the diamond-point chisels Not only would the oxygen do the work, but best of all, it would do it both faster and cheaper So. again, away with clang and clatter! Quiet oxygen would soothe frayed nerves! And lo and behold, overall plant efficiency increased almost 15 percent in one plant-attributable to noise elimination alone

As the pressure vessel industry grew, demands were made for heavier and heavier plate Economical welding procedure demanded U-shaped welding grooves Until quite recently the only tool for making these welding grooves was a plate planer About the only objection some shops had to the installation of a plate planer was the cost For a good plate planer costs more than eight times as much as the most expensive oxygen bevelling equipment. Back to their researches went the oxygen men And out of their work came efficient oxy-acetylene plate edge preparation at a cost within the



Steel is cut cleanly, rapidly with the exy-acetylene torch

reach of all When the oxy-acetylene torch completes its work, the plate edges may be placed together to form a perfect groove

Increasing temperatures and pressures placed great responsibilities upon the shoulders of pressurevessel manufacturers. To prove the quality of the welds they made, they pressed into service the X-ray As was anticipated, the X-ray pictures disclosed infrequent defects



Photos Air Reduction Sales Co
Using a template guide, an
oxygen torch cuts machine parts

in the welds Such defects were chipped out—a slow and laborious process Luckily, the same tool that was used for gouging the unwelded portion of a seam and for plate edge preparation, might be used for removing these defects

For some time, the use of the oxy-acetylene torch for severing steel has been common knowledge Even the adaptation of this tool to rough-shape cutting has been known by many But the development of precision tips, that eliminated all other finishing operations involving the use of machine tools, came quite recently. Here the perfection of precision nozzles led to unbelievably close tolerances How close? Well, from three-thousandths of an inch in one-inch plate to slightly more than three-hundredths of an inch in six-inch plate

Meanwhile, the men in oxygen research saw another opening for their tools. For many years, the painting industry had been preaching the importance of the proper preparation of steel for painting, Sand-blasting, pickling and chipping had all been used with success. Each process had its advantages and disadvantages, of which the latter were mostly concerned with

the slowness of the process. A special tip emerged from the development division to use oxygen in combination with acetylene for rapid and certain flame descaling By quickly raising the scale on the surface of the steel to a high temperature, the descaling torch turned the trick Differential expansion of the oxide skin and the steel below caused the scale to fly off. The scale-free dry steel that remained was ideal for nantume.

Now we come to one of the most recent milestones on the oxygen road of progress hole-drilling in both stone and concrete Rock is quarried by drilling blasting holes in which dynamite is used to blast huge blocks of material out of the formation in which they are found. Heretofore this drilling has been accomplished by cumbersome and expensive machinery. Once more the operators might have struggled along with both heaviness and cumbersomeness if the machines hadn't been so slow. Then along came a special oxy-acetylene torch and tip that drilled the holes in rock with speed Although speed ruled. I must admit that the lighter equipment and greater economy which were thrown in for good measure helped to swing the balance in favor of the flame process

Frequently holes must be drilled in concrete This stubborn and unyielding man-made lock is conquered slowly with a star drill and pneumatic gun Powdery concrete emerges from the hole so slowly as to tax the most angelic patience. No rapid drilling of concrete was ever possible, that is, not until the advent of oxy-acetylene drilling

Both stone and concrete contain, water. In flame drilling, the concentrated heat of the oxy-acetylene flame turns this water to steam. The steam, trapped as it is on all its sides, explodes And the hole is sides, explodes And the hole is with speed but also over the oxy of t

Ever notice a runner at the end of a long race? He is fighting for oxygen to replace that which he has burned up while running Not so industry Industry is breathing easier in its oxygen tent. This ubiquitous gas has eased the struggles of industry in many places.

Nothing has been said here about welding, brazing, or soldering with the oxy-acetylene torch. Nor has anything been said about flame hardening or flame softening. But why go on? Even as I write, the oxygen men are putting the finishing touches to developments that will make the story of oxygen even more unbelievable

HOT-SPRAY

Lacquer Finishes Applied Faster -

And at Less Cost

In virtually every system of surface finishing, the ultimate object is to obtain the greatest degree of permanent protection with the least amount of labor and material The cost of the finishing process is proportionate to the amount of solids on the surface when the finishing operation is completed

operation's complexity these basic In strict keeping with these basic principles, the new P&S hot-spray lacquer system produces, in a twocoat finish, the solids ordinarily obtainable in a three-coat cold lacquer finish. The heat employed in this machine gives spraying consistency without the use of thinners or solvents Consequently, with this equipment, the manufacturer claims economies in amount and cost of material used, application time drying time, and labor and handdrying time, and labor and hand-

SPRING ISOLATOR

Machine Mounting Damps

Noise and Vibration

A NEW, easily installed wbration isolator, designed as an economical means to control machine wbration and reduce the resulting noise, was recently announced by Johns-Manielle This devuce, known as the J-M Controlled Spring Isolator, was developed for use on the bases of motors, generators, pumps, ventilating fans, and symilar equip-



Sectional view, spring isolate



Motor on spring isolators

ment where vibration and excessive motion create noise and tend to wear out machine parts and damage connections as well as to crack the supporting walls and floors

The working parts of the unit consist of a coil spring and a rubber load pad, which support the equipment and isolate vibration-and an adjustable rubber snubber inside the base, which controls excessive motion

The isolator is built to take care of horizontal and torsional as well as vertical vibration. It is efficient for the low frequency vibrations resulting from slow speeds and from many operations involving recipiocal motion. The load pad is designed to overcome any high frequency vibrations

The device is made in two sizes Light duty, for loads from 50 to 190 pounds per isolator, and heavy duty, for loads from 250 to 720 pounds per isolator. Heavy machines may be isolated by clusters of the units The loaded overall dimensions of the unit are six by six inches by approximately 334 inches high It is enclosed in a metal jacket which protects the rubber parts from oil and light

FACTORY RUBBER

New Synthetic Useful

For Tires

In page 125 of this issue, Philip H Smith touches upon the so-called synthetic rubbers, indicating that we are not yet in a position to replace natural rubber with the synthetic variety. The newest of these synthetics, which is equal or superior to natural rubber in many of its properties and can be processed and vulcanized like the natural product-in making tires, for example-is claimed by the developers to be capable of radically reducing our dependence upon natural rubber which must be imported Of course, this factory product is more expensive than latex rubber and only in a great national emergency would sufficient plants be constructed to make it in large quantities

The basic raw material for this new factory-made rubber, which has been named Ameripol by the B F Goodrich Company, is American petroleum Dr Waldo L Semon, its discoverer, explains that the petroleum is broken down by the cracking process to a mixture of simple molecules From this mixture can be separated a gas which, under pressure, liquefies to give butadiene. This is mixed with other ingredients prepared from natural gas and air and then made into a milky emulsion, using soap produced from American agricultural sources. Upon heating and agitation, these ingredients react to form an emulsion of synthetic rubber, which is similar to the latex obtained from rubber-producing trees From here on, the process of obtaining a sheeted rubber is quite like that used for natural rubber The latex is coagulated with acid, producing a curd This is then sheeted and dried to

PROGRESS

Hand of Research, a Midas Touch on Machines

give the Goodrich synthetic

For the benefit of all those who may be critical of scientific research in any respect, we present an accompanying photograph showing four versions of the lowly washing machine. No women accustomed to the 1940 model would ever be content to use again the 1919 model Yet despite the significant story told in this group picture of four machines, there are still some people who claim that new models are built solely for catch-penny nurnoses-to exploit the consumer Scientific research made possible part of that improvement being the half for a modern machine that

the vast improvements shown in this group picture, not the least reduction in piace by about one does better work than its earlier prototype

MOLDED AIRPLANES

New Pressure Tank Ordered For Production

A SUPER-SIZE molding tank for socalled plastic airplanes and parts has been ordered for the Duramold Aircraft Corporation, a subsidiary of Fairchild Engine and Airplane Corporation The tank, 10 feet in diameter and 28 feet long, will be installed in the Grand Rapids plant of the Haskelite Manufacturing Corporation, co-owners of the Duramold process The quick-acting door of the tank alone weighs 13 tone

The so-called plastic airplanes are not, as is generally thought, made by pouring a plastic into a hollow mold, but rather are made of wood fibers in the form of thin veneers bonded together with plastics under heat and tremendous pressure | See Scientific American, July 1939 —Editor | By utilizing and preserving the tremendous natural strength of properly arranged wood fibers, a new material is obtained, which is not only stronger and lighter than pure plastics, but one that compares favorably with riveted aluminum alloys Duramold engineers emphasize the fact that all the raw materials used in plastic airplanes are available in large quantities in this country

Duramold Aircraft Corporation was the pioneer in developing synthetic materials and processes for molded airplanes and flew a plane,



One of many examples of industrial progress brought about by research

with a molded fuselage, over two years ago Production molded units made by the Duramold process are now in use in the Fairchild Army training plane and on planes of one of the major airlines

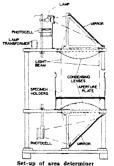
According to Modern Plastics magazine, four aircraft companies are now working intensively on the problem of moded airplanes, two major research institutions are investigating various phases of the subject, and the Army Ali Corps and the Navy Bureau of Acronautics are closely watching all developments as well as carrying on tests in their own laboratories

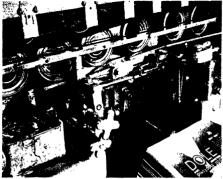
AREA DETERMINER

Machine Measures Areas Fast and Accurately

PLANIMETER measurements areas are slow While they are relatively accurate they are not exactly so A new area determiner developed by the American Instrument Company utilizes a photoelectric cell and accurately ground optical lenses and is, therefore, faster and more accurate than any device depending upon the human senses. It will determine the areas of maps, printed designs, stampings, punchings, engine indicator diagrams, plant leaves, and many other irregularly shaped flat obrects that will fit into a 9 93-inch circle If the object is transparent, it must be temporarily coated with a translucent or opaque material

Inside the 42-inch high cabinet are two 12-inch condensing lenses.





Can labeler; paste (left), label pick-up (center), label pile (right)

two diffusing screens, two mirrors, and two photo-electric cells A galvanometer is used for determining the balance point between the two cells. To operate the machine, after plugging it into a 115-volt socket. the dial on the face of the cabinet is first set at zero by balancing the two cells. The flat object to be measured is then placed between glass plates over one of the lenses. The galvanometer deflects and is then brought back to zero by turning the dial Finally, the dial reading is multiplied by five to obtain the area in square centimeters

LESS TIN

New Tinning Process Saves Vital, Imported Metal

In is one of those vital raw materials which the United States must import. Although this country uses a relatively small amount—about 40.000 tons yearly—to make tin cans, there is not yet a completely satisfactory substitute for it. Therefore, if our imports from the Dutch East Indies and the Stratist Settlements were cut off, an enormous canning industry would feel the pinch of the war.

Professor Colin G Fink, of Columbia University, from whose laboratory many metallurgical and metal plating processes have come, has now developed a process which permits much thinner tin plating on the iron sheet that makes the tin

can According to recent reports, this process would save half the tin now used for this purpose His new process involves electrochemistry instead of dipping

RAPID LABELER

1400 Pineapple Cans Labeled Per Minute

The fact that up to 1400 cans are labeled per minute at the Hawaiian Pineapple Company's canners in Honoliulu is a record made possible by improvements on standard can-labeling machinery All of the machines were originally standard Knap machines, but have been re-designed to raise the speed as much as 50 percent over that at which the labelers are usually operated

The Hawaiian Pineapple Company, growers and packers of Dole products, evolved a new design to speed up the operation of the original labeler. The pick-up paste pan has been fitted with two sets of rollers, both machine driven One rotates clockwise, the other counter-clockwise One set of rollers is grooved like a pulley, while the other set is pointed and operates within the groove of the first set The pointed rollers are on a shaft made adjustable to increase or decrease the space between the meshing rollers. This permits the application of either lesser or greater amount of pick-up

paste. The rollers are self-cleaning

Another improvement was the introduction of a new method of feeding the cans into this fast moving machine Trays of cans are upended so the cans roll by gravity onto a belt which passes them in an almost uninterrupted stream across the paste pan rollers supply labels to the machine, a slip drawer, which falls back to a slightly out-of-plane position, is filled with labels while the machine is running. When the labels in the machine have been used. this slip drawer is simply pushed forward into the machine after the table has been lowered to receive them The drawer is then removed and the machine continues its operation with practically no shutdown

ROTORS

Improvement in Induction

Motor Construction

OFFERING the advantage of longer motor life with less maintenance. a new type rotor construction announced by General Electric makes possible the use of cast-aluminum rotors in the larger sizes of doublesquirrel-cage motors for highstarting-torque, low-starting-current service Called the "Valvamp" rotor, it makes use of a unique shape of rotor slot and a special method of assembling rotor punchings to control the flow of starting current As a result without the use of a switch or other moving parts, current is permitted



Section of cast aluminum rotor

to flow in the outer squirrel-cage when the motor is started, thus producing high starting torque Then, when the motor comes up to speed, current is allowed to flow through the entire rotor "winding," resulting in excellent running characteristics

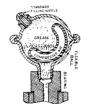
Of the two conventional methods of double-squirrel-cage-rotor construction—that is, casting the conductor bars and short-circuiting rings integral, or joining them by brazing—the former method as by far the more satisfactory because it is a simpler operation, with smaller chance for human error, and results in a more compact, uniform product However, until the Valv-amp development, it has not been practicable to cast double-squirrel-cage rotors in the larger street.

The Valv-amp development, however, allows the construction of larger cast-rotor motors which inherently combine the advantages of the double-squirrel-cage motor, such as high starting torque, low-starting current, and excellent running characteristics, with advantages of the conventional cast-rotor motor—simplicity of construction, long motor life, little maintenance, and permanence of electrical characteristics

PRESSURE LUBRICATOR Flexible Ball of Neoprene Uses

Compressed Air

A continuous, positive flow of lubricant to the wear surface of bearings while they, or the shafts,



are in motion is assured by a new pressure lubricator which is permanently attached to the lubrication passages. This device utilizes compressed air, stored in a neoprene ball, to force lubricant to each individual bearing as it is needed by that bearing

The lubricator consists of a steel shell, designed to withstand high pressures, inside of which is a hollow, flexible neoprene ball. The shell is equipped with a standard grease fitting and a pipe-threaded outlet that screws into the standard lubrication passage.

When grease is forced into the lubricator by a pressure gun attached to the grease fitting, it col-

lapses the neoprene ball against the pressure of the air inside of it thus compressing this air and storing up energy After the lubricator has been filled under high pressure, the grease flows through the bearing rapidly with a flushing action until the pressure within the lubricator drops to where it balances with the resistance of the bearing to passage of lubricant When this static condition has been reached, further lubricant is forced to the bearing only when the bearing is in motion. The pressure balance is unget only when the bearing or the shaft is moving, causing loss of lubricant and the consequent need for replacement of the grease or oil

replacement of the grease of oil. The flexibility of neoprene and the ability of neoprene compounds to resist the passage of gases were two principal reasons for the selection of this material for the ball In addition, the use of neoprene was dictated by other conditions of service—the lubricators must be effective in cold and hot weather, and they must handle all types of lubricants without appreciable deterioration of any of the parts necessary for their operation—The Neoprene Notebook

EYE ACCIDENTS

High Toll of Industrial

Eve Accidents

ALTHOUGH safety engineers have long inveighed against the carelessness of workers who will not use the prescribed goggles when doing



dangerous work, that carelessness continues It takes a heavy toll. The American Optical Company emphasizes the cost with the accompanying photograph, their caption saying: "It would take all the artificial eyes in this basket, and more too, to replace the 2000 eyes lost annually in eye accidents."

Such accidents cost American industry approximately \$37,000,000 yearly in medical expenses and compensation.



CONTINUOUS CASTING

Revolutionary changes are taking place in the hot handling of metals. During the past few years the metallurgist's century-old dream of producing billets, sheets, and strip direct from the molten metal in a single step has materialized Billets of copper, aluminum, and magnesium alloys are being produced commercially right now and it appears that steel will soon be added You're unlikely to hear about this because the art develops slowly, without publicity of any kind, and in some instances with absolute secretor.

Actually, the process is one of continuous casting In this country and in Europe there are mills casting ingots and billets of ferrous and non-ferrous metals on a 24-hour basis to prove the practical nature of the method A New England producer is now casting over one million pounds of 7%-inch brass rounds weekly with a single machine, and it is possible to cast continuously billets up to 20 inches in diameter

There are half a dozen systems in operation, commercially and experimentally. They differ as to technical details rather than as to basic principle. The molten metal flows from a holding furnace into molds which are jacketed for cooling, then, as the billet comes from the mold, it is cooled by sprays and passes on down to a cut-off saw or flame which cuts it into desired lengths. While the processes are very simple, there have been many difficulties to iron out, because so much care has to be given to temperature control, operating speeds, and molds.

Speed of production is the great achievement. According to the system, kind of casting, and its size, output may vary from 10 inches to 7 feet per minute, and these speeds are likely to be raised with further experimentation and experience.

IN STRIP FORM

To anyone familiar with rolling mill practice, the production of sheet and strip by continuous casting is more dramatic than the turning out of billets. Instead of employing multiple passes through rollers to reduce a chunk of metal to the form of sheet or strip, a single pass of the molitien metal will produce thin strip (about 0.02 of an inch in diameter) of eight-inch width at the rate of 500 and more feet per minute.

There is insufficient space for relating the experiments and heartbreaks leading to ultimate success in continuous casting. It is sufficient to say that it is used to handle non-ferrous metals and more recently has demonstrated the capacity to handle high chrome, high carbon, and spring sites!s. There's no doubt but that it can produce tin plate, but it has yet to prove that it can outmode the great continuous rolling mill for production of automobile sheet.

Enough experimental data have been assembled to warrant the forecast of further triumphs. It is very likely, for example, that the continuous casting of tubing is not far off. This would be accomplished by inserting a stationary mandrel in the forming mold. It is also likely that the new practice will prove valuable for handling stainless and other high alloy steels because of the reduction in scrap loss.

EVERYTHING BUT THE SQUEAL

Do you recall the time honoied phrase that the meat packing industry utilized every part of the hog but the squeal? Well, that's literally true, but that is no indication that the industry has reached the end of the utilization goal. The industry has shown great ingenuity in developing outlets for all the various packing by-products, but the application of science is going to find still more valuable uses and thus create vast changes for the industry and its dependents

I could tell you that the various glands are used for pharmaceutical preparation of hormones, that the livers of calves are used in the preparation of soluble extracts to combat anema. It might interest you to know that gall stones, found in some cattle, are shipped to the Orient where they bring as much as \$150 per pound for use as amulets, but it is more to the point to tell of recent events and forecast some more

It has just been announced that the june of the tropical guardum tree, used in small quantities, will prevent the oxidation of lard, so that it can be kept without refrigeration and its nutritive values preserved without chemical change. This is a discovery of great value. The lard market has shrunk under the competitive onsluight of the hydrogenated vegetable oils, known to you under various trade names, and more recently the export market has been subjected to fire. It has been with a total the same and to the packers to revive the market.

Lots of work is being done with gelatine Notably, several universities are studying its fatigue-relieving effects under controlled conditions. Gelatine already has a substantial market to capsule a host of products, but it can benefit from a bigger one. Blood goes into the manufacture of adhesives and has been employed to bond cheap plywood. I venture to say that fundamental studies into the nature of animal blood will be made to give it a value which at the moment is the very low. Certainly scientific progress is being made in the packing industry, and I hope to be able to announce another important discovery at an early date.

STRATEGIC MATERIALS

War has unquestionably dislocated trade and shut off the flow of commodities between this country and a large and important section of the world, but as to ultimate effect upon American industry, one man's guess is nearly as good as another's

Viewing the kaleidoscopic events, this much can be said 'Our situation in supplies of strategic materials is much better than it would have been had similar upset conditions existed a few years ago (See Scientific American, March, 1936). The rubber problem seems pretty well licked by ersatz developments, although over-night production in any quantity is out of the question. We could get un from Bolivia, but we lack the smelters necessary to refine it. It's more likely that the need for tin as a plating agent would be met by substitutes, leaving available supplies for more essential items. A possible substitute is black steel plate, coated with lacquer, another is aluminum, used as a plating

To these chemical contributions to self-sufficiency can be added substitutes for fulminate of mercury in detonators, chinacrin and plasmochin to replace quinine, and they are talking up nylon to replace silk in powder bags and parachutes.

- Philin H. Smith

First Aid For Burns

Application of Tannic Acid is Procedure That Has Received World-Wide Recognition

CHARLES A. McAVOY

The standard first aid for burns in the United States Navy is an aqueous pelly contaming 5 percent tannic acid and 0.5 percent phenol Tannic-acid jelly was adopted by the Burcau of Medicine and Surgery of the Navy after tenyears' successful use of tannic acid in the treatment of burns by the leading hospitals of the world

Tanne-acid treatment of serious burns was introduced as the result of work by the late Dr E C Davidson of the Food Hospital, Detroit Di Davidson was searching for a coagulant of proteins and most of his early work was with phosphotungstic acid His attention was drawn to the fact that, for many centuries, the Chinese had used a strong decoction of tea in the treatment of burns, he replaced phosphotungstic acid with tannic acid and obtained brilliant results

In 1925, Dr. Davidson announced the results of his work. His paper led to a world-wide adoption of the led to a world-wide adoption of the ratin the annou-and treatment of burns and much work and study was carried on by others to perfect the technique. Most important was the development of tannic-acid jelly which brought Dr. Davidson's dissectiver with the field of first and

First aid in serious burns, as in the injuries must be based on the fundamental principle of first aid—"the avoidance of further damage to an injury between the time of the accident and the beginning of medical care."

It is essential, therefore, to consider just what is the most frequent and most serious "further damage" which the first-aid worker must strive to avoid in handling serious burns

A study of current medical opinion establishes four important facts the majority of deaths in serious burns ensue from shock and collapse correct first-aid measures should be instituted immediately after the accident, oily or greasy

preparations of whatever type must not be used as first aid, the accepted method of treating burns is the application of 5 percent tannic acid, either as a spray or aducious felly

It is stated that 80 percent of deaths from burns are due to shock and collapse. The first-and worker should be fully aware of this danger and his efforts should be to prevent or retard the development of shock during the period between the accident and medical care.

in a determination of the causative factors in which is the causative factors in which is the causative factors in which is the causative factor in the causative factor in the causative factor in the causative factor in which is the most dangerous and that shock is the most dangerous factor involved in serious burns and that preventive measures should be taken immediately

HOCK begins with the injury and Shock begins with the mind the first aid must be immediate in order to be effective. Every minute of the time required to transport a burned patient to a hospital adds to the danger of shock During the period intervening between a serious burn accident and medical care, symptoms of shock may develop, retarding the efforts of the physician Tannic-acid jelly should be applied immediately. If the injured person is conscious, some fluid should be given. The body of the injured person, including the burned area, should be kept

The standard procedure in all hospitals is to treat burns with aqueous sprays Most hospitals use sprays of tannic acid or some modification of tannic acid, while others use aqueous solutions of certain dves In all instances, however, the spray solution is aqueous and depends on penetration for its therapeutic value If preparations containing oils or greases have previously been applied as first aid, the oils and greases must be removed with solvents before the aqueous spray can be used In cases where the burn covers a

large area, or the patient is in shock, the "scrubbing" of the injury becomes a serious factor.

The disaster to the airship Hindenburg caused many serious burns to be treated at the hospitals at Asbury Park and vicinity, Dr O. R Holter, of Fitkin Hospital. Asbury Park, New Jersey, wrote in the September, 1937, issue of the Journal of the Medical Society of New Jersey regarding his experiences with serious burn cases following the wreck In the course of his article Dr. Holter said "The use of oils and ointments of various kinds, home and proprietary remedies, in the treatment of second and third degree burns is to be severely condemned "

The tannic-acid treatment of burns introduced by Davidson has revolutionized both hospital and first-aid procedure in the case of burns. Philip H Mitchiner, M.D., M.S., FRCS, in his excellent article, "Treatment of Burns and Scalds." (British Medical Journal, January 1, 1938) points out that, while the value of tannic acid in burns is due to its coagulating properties, it is important that the solution should have a penetrating action as well Tannic-acid solutions of 5 percent or less penetrate deeply, so that all of the damaged cells are coagulated and the danger of a superficial coagulum (which permits toxin absorption from the deeper uncoagulated tissue) is avoided

Treatment with tannic-acid spray, however, must always be under optimum conditions. The patient must be kept warm, the injury kept warm under a heat tent, and the solution sprayed on must be warm Spraying must be repeated frequently for hours until the coagulum is completely formed

Sub-optimum conditions, however prevail at the scene of an accident involving burns. Under these conditions, it would not be possible to maintain the patient and the injury warm during the treatment with tannic acid spray, even though there might be an operator trained in the technique

With the application of tannocand jelly, the coagulum forms as acid jelly, the coagulum forms as the patient awaits medical attention and is complete in 30 to 40 minutes. No skill is required and no time has been lost, the application can be made even under untavorable conditions and two applications should suffice. This is correct first aid.

Aqueous tannic-acid jelly has

-HEALTH SCIENCE-

the penetrating and coagulating properties of the spray: it seals the injury rapidly, retards loss of body fluids through the burned area, excludes air and stops irritation of nerve endings, thereby allaying pain. The danger of shock is reduced as the patient awaits medical Being water-soluble, the tannic-acid jelly or its coagulum can be removed by the surgeon without undue discomfort to the patient Tannic-acid jelly not only brings the benefit of the tannicacid treatment for burns to the field of first aid but likewise coordinates first aid with later med-

In summarizing, the most important message to the first-aid worker in handling burns is that he act immediately to minimize or prevent shock in the injured He can best do this in the following manner.

Apply tannic-acid jelly freely over and beyond the burned area In first aid avoid the use of sprays

If the patient is conscisping structure is a patient is conscious, administer some fluid to replace loss of body fluids. Keep the burned area and the patient warm. Do not use any preparation containing oils or greases. Bring the patient under medical care as soon as possible.

STIMULATING

Modern Version of the

"Medical Coll"

REFLATED to many attics are "medical coils" — induction coils is"— nit of the company of the com

Modern medical research, howwer, has found that similar currents do have value in certain cases. Thus, portable muscle stimulating equipment for physicians, a General Electric medical development, is a recent application of one of the oldest facts of electrical knowledge. The purpose is to increase circulation, to hasten, repair, and restore function as soon as possible after enforced rest or immobilization of skeletal muscles following fracture or other injust.

The apparatus, which can be adjusted by use of a vacuum-tube rectifier for either alternating- or direct-current operation, conveys to the patient through the two electrodes just enough electricity to produce a neuromuscular response at the rate of 12 contractions per minute, each simulating a natural contraction in its gradual rise to completion, with a correspondingly gradual fall to relaxation.

The name of the device, a galvanic generator, recalls Luigi



The "medical coil" up-to-date

Galvan, the famous professor of anatomy at the University of Bologna, who about 1791, while prepaing frog's legs for his ill wife's dinner, noticed that electricity caused their muscles to twitch and contract

FAIR EXCHANGE

Men and Women Swap Clothes
To Bring Out Suspected Facts

Momen are two degrees cooler than men by skin temperature readings but the chief reason the sexes cannot agree about what is a comfortable indoor temperature is that women's clothes are cooler. This was proved to a group of men when they donned women's filmy garments in scientific studies at the Harvard School of Public Health

The studies were reported to the American Industrial Hygiene Association by Dr. C. P. Yaglou

"Men dressed in women's summer clothing (weighing 18 pounds including shoes, compared with men's summer wear of five peunds) demanded a temperature of 80 degrees Fahrenheit, which was about the same as that preferred by women (79 5 degrees) similarly dressed," Dr Yaglou reported

"Reversely, when women wore men's winter clothes (8 3 pounds instead of 2 6 pounds, the average of women's winter garb) the comfortable air temperature was just as low (70.5 degrees) as that preferred by men wearing the same clothes."

If men would wear a coatless and vestless dress with the lightest of underwear in hot summer weather, rooms would not have to be cooled below 85 degrees Pahrenheit for comfort, Dr. Yaglou said The present standard is from 76 to 80 degrees. With men garbed for a temperature of 85 degrees Pahrenheit in summer, there would not be the trouble now experienced from exposure to sharp temperature contrasts between apparently chilys air-conditioned buildings and the heat outdoors.

In winter, Dr. Yaglou said, a room temperature of about 70 degrees Fahrenheit would be comfortable for both sexes in the coldest weather, if women wore more and warmer clothes and buildings were suitably insulated—Science Service

POISON IVY

New Method of Protection Excludes the Poison

A VANISHING cream that gives protection against poison ivy has been developed by Dr. Louis Schwartz, Dr. Leon H. Warren, and Frederick Goldman of the United States Public Health Service and the National Institute of Health, Washington, D. C. The cream is made by correctly maing either sodium perborate or potassium periodate with vanishing cream.

Tests on nine volunteers showed that the cream protects against both poison-nye extract, which is at least 30 times as powerful as any poison ivy leaf, and against the leaves and stems of the plant itself. Two volunteers, one most susceptible and one medium susceptible to poison ivy, after inbbing on the cream, pulled out poison ivy, after inbbing on the cream, pulled out poison ivy plants by the roots, plucked the leaves, and rubbed them over their skins. Neither volunteer was poisoned.

The cream is made by adding 10 percent sodium perborate, or 2 percent potassium periodate, to vanishing cream The chemicals come in crystal form and should be ground to powder before mixing The vanishing cream should be made first and the chemical added The cream should be freshly prepared for use, to avoid deterioration.—Science Service

Interstellar Gas

More and More, Astronomers are Finding Matter as Particles Between the Stars

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnesie Institution of Washinston

N unusually interesting discovnamely, that molecules of chemical
compounds, as well as isolated
atoms, are present in the excessively rarefied gas which is found
in the vast "empty" spaces between
the stars. The evidence, of course,
comes from the spectra of distant
stars whose light has traversed long
paths through interstellar space

It has been known for many years that the H and K lines of calcium (absorbed by the ionized atoms of the element) are present in the spectra of many very hot stars, and are very sharp-mere hair-lines across the spectrumwhile the other lines are broad and fuzzy. The latter behavior is easily explained as a result of rotation of the stars, and of relatively considerable density in their atmospheres-both of which tend to widen the lines. But the sharpness of the calcium lines indicates that they originate in a gas of very low density, remote from these disturbing effects. A cumulative weight of evidence has convinced everyone that this gas is nowhere near the individual stars, but distributed generally-though probably more or less patchily - in space The yellow D lines of sodium were next found to appear with the same characteristics in the same stars Later the ultra-violet pair of sodium was discovered, the red line of potassium, several lines of titanium, and, in a few cases, the strongest line of neutral calciumthough very faint

It is now evident that interstellar space is by no means empty. Indeed, there is probably a great deal more in it than our spectroscopes can detect

We may recall that an atom of titanium (for example) can exist in a great many different states characterized by different amounts of internal energy (definitely fixed for each one). An atom in any one of these states will absorb only a definite group of the numerous lines of the spectrum-the others coming from atoms in other states For some atoms, such as sodium, there is one "ground-state," much lower in energy than any other, so that, in the ordinary metallic vapor in the laboratory only a very small fraction of the atoms are excited into the higher states, and the absorption by the vapor shows only the "ultimate" lines coming from the ground-state For others, like titanium, there are many states with energy only a little above the bottom, and light passed through a column of vapor in an electric furnace shows absorption from a numher of these states

But the interstellar lines of titathe very lowest state only atoms in states of even a little higher energy must have some way of getting rid of it, and falling back to the lowest level From most energy levels an atom can do this by giving out an ordinary line of the familiar spectrum, and it is practically sure to do so in less than a millionth of a second, but the transitions from the lower metastable states to the bottom are "forbidden"-which means that they will happen only if the atom is left to itself without disturbance for an enormously long time-such as a second-or even several minutes in extreme cases. The interstellar gas is, however, so very thin that its atoms will go weeks, or perhaps months, on the average, between collisions So they have plenty of time to settle down, and the observed situation could have been predicted.

For many of the most interesting elements, such as hydrogen, helium, carbon, nitrogen, oxygen, neon, magnesium, and silicon, the lines

absorbed by atoms in the groundstate lie in the far ultra-violet, and we have no hope of observing them through the ozone in the Earth's atmosphere - which lies like a black pall upon the dreams of the astrophysicist. There does not appear to be much chance of observing interstellar lines of other elements than those already known The main reason is that the radiation of the stars tends to remove electrons from the atoms and ionize them, and the chance of picking up electrons again from those wandering about in space is poor. The lines of neutral calcium are much fainter than those of ionized calcium, and Dunham calculates that there are 3500 ionized atoms for each neutral one. Even for iron, which is harder to ionize, only one atom in many hundreds should be neutral

This explains why we do not find interstellar lines of aluminum and iron. The neutral atoms have lines in good observable positions, but those of the ionized atoms are lost behind the azone.

In view of all this, it is surprising that a number of sharp, characteristic interstellar lines have been observed and not identified. Their positions, which have been accurately measured, do not agree with the ultimate lines of any known element—and our lists of such lines from laboratory observations are undoubtedly complete (in this region of the spectrum, at the least). There must be something else besides atoms in interstellar space, to absorb them.

One naturally thinks of molecules but af first a great difficulty appeared. The spectra absorbed (or emitted) by molecules are extremely complicated, containing thousands of lines grouped together in bands, often so closely that only the most powerful spectrographs will resolve them. How can such spectra reduce to a few isolated lines such as are observed?

An answer comes by applying the principle already revealed by the atomic spectra—that all the absorbing systems (whether molecules or atoms) will be in the lowest levels of their ground-states.

est levels of their ground-states. Changes in the energy-state of an atom depend on changes in the configuration of the electrons in its outer regions. This can happen in a molecule, too, but so can many other things Even in a simple diatomatic molecule, the two atoms may be rotating about their center of gravity; or they may be vibrating, changing their distance on each

- ASTRONOMY-

side of the mean value. Long series of these vibrational and rotational states are permitted by the quantum rules, and transitions between them give hosts of regularly-spaced lines. When there are only two atoms in the molecule, it is possible, with much labor, to work out just what states of oscillation and rotation correspond to each line. With three or more atoms, the complications are much worse.

Now, when left to itself in interstellar space, a molecule will get rid of its energy (by radiation of forbidden lines), and settle down into a state in which the rotation and oscillation have diminished to the smallest amounts permitted by the quantum laws (which are not always zero) A molecule in this state can absorb only a very few of the host of lines which compose the familiar bands in its spectrum What is more, the residual line to which the spectrum is thus reduced will not usually be the strongest one in the completely developed band. Which one of the lot it is can be found only when a detailed analysis is made, but for a number of the most important band-spectra such analyses are on record and available

UTLIZING these data. Dr Andrew McKellar, of the Dominion Astrophysical Observatory at Victoria, has shown that the interstellar line at 4300 24 agrees perfectly with the residual line of the control of

The agreement of the laboratory and interstellar wavelengths is so good in each case as to afford strong evidence, but more is forthcoming There are three more accessible bands of the CH molecule, each of which, under interstellar conditions, should reduce to a single line. at 3878 8, 3886 39, and 3890 23 In the spectrum of Zeta Ophiuchi, which shows strong interstellar lines, Adams at Mt. Wilson has found all three of these, in very close agreement with the laboratory positions, and with relative intensities as predicted His statement. "The evidence for the presence of molecules of CH in interstellar space seems to be conclusive," is none too strong in the circumstances.

Other lines of CN and NaH are also available for a test, but have not yet been looked up; but there is no reason to doubt their presence also Molecules of other kinds are presumably present, for there are sharp interstellar lines at 1987 and 4233 which are not yet classified Their identification may have to wait upon a detailed analysis of other band spectra

There are also three lines in the red, clearly of interstellar origin, but relatively broad, whose origin is still unknown

These molecules, whose presence has been detected spectroscopically, all look queer to the elementary chemist. He would expect to find CH, (methane) instead of CH, and C2N2 (cyanogen gas) instead of the half-decomposed CH The spectroscopist, however, is not surprised He knows that complete, saturated molecules such as methane have their strong absorption bands far in the ultra-violet or the infra-red, out of reach of the astronomer (The methane bands observed in the outer planets correspond to weak absorption, which would not show up at all unless the quantity of the gas was enormously great in comparison to what we have been talking about) Partly dissociated molecules - chemical radicals-which are too active to remain in the free state in ordinary laboratory experiments, often show absorption in the observable re-

It is highly probable that there are ordinary saturated molecules, too, in interstellar space Common hydrogen (H₂) and nitrogen (N₂) should be there if CH and CN are, and in addition there may be molecules of oxygen and other things as well.

The chemical equilibrium of such a mixture of gases, containing molecules, free atoms, ionized atoms, and free electrons, affords a complicated and intriguing problem for the theorist. We have already some idea how thinly the atoms are strewn. Dunham, a year ago, calculated that in a typical interstellar region, there is one neutral sodium atom for every 20 cubic meters, and one singly ionized calcium atom for seven cubic meters The neutral calcium atoms are far less numerous-one to 25,000 cubic meters, or 160 atoms per cubic mile, as against 200,000 neutral sodium atoms. Sodium produces almost the strongest interstellar lines, and neutral calcium the weakest so far observed. The number of molecules of CH per cubic mile is probably a few thousand

To maintain even this small number of neutral calcium atoms against the tendency of starlight to ionize them, there must be many free elections-probably at least one per cubic centimeter, or 40 million billions per cubic mile. These must come from ionization of atoms of some sort-probably mainly from hydrogen Under the assumed conditions, hydrogen would be about 95 percent ionized. which would leave two million billion neutral hydrogen atoms per cubic mile Only an excessively small fraction of these enter into the observed hydrocarbon compounds How much carbon nitrogen, and so on there may be we do not yet know-but the amount may be roughly calculable, at least, when the problem of the dissociation of molecules under these extraordinary conditions has been

THE density of the interstellar gas, measured by any ordinary standards is almost inconceivably small. with one hydrogen atom (or free proton) per cubic centimeter. The density comes out 1.7×10^{-24} that of water, or less than two ounces in a cube 2000 miles on a side Inside a space as big as Neptune's orbit, there would nevertheless be 600 000 billion tons-one ten-nullionth of the Earth's mass-enough (if of suitable composition) to make a big comet or a small asteroid But inside a sphere of radius equal to the distance of Alpha Centauri, these would be 4.7×10^{32} grams, or almost a quarter of the Sun's mass

The total quantity of matter in this intersteller gas, on these calculations, is then a considerable fraction of that which is concentrated into the stars themselves These numbers are rough, and may be greatly altered by later and more precise calculation, but, as they stand, they do not appear very favorable to the hypothesis that the interstellar gas has been ejected from the stars-as eruptive prommences are occasionally driven off from the Sun, and hydrogen and other elements continually expelled from the Wolf-Rayet stars There seems to be too much of it to be accounted for in this way, and most of it may have been "originally" there-whatever this means.

-Princeton, July 3

Build No Freaks

Warships Can Be Better Designed To Meet Needs of Their Own Classes

BROCKHOLST LIVINGSTON

For centuries man has sought some revolutionary form of weapon which might overcome all defense. He is still seeking Both on land and sea, tired forms of warfare have succeeded where novel weapons have failed—no offensive means has ever been discovered that could not be parried. On the sea the ram, the monitor, the dynamite ship, and even the submarine and the airplane have appeared, but defenses against all of these have been developed.

With this nation clamoring for additional defensive equipment it behoves us to move cautiously, to give caim consideration to any proposals for so-called revolutionary weapons. The means we provide for our defense must be the best available but the imaginings of our feature writers should not be permitted to dictate our pocurement policy.

In our present quest for the most effective weapons of defense, we are examining, and properly, the possibilities of every type, from tiny motor torpicol boats to Gargantuan battleships When our studies are completed we shall probably find, as we have in the past, that tried types of weapons

both on land and sea must be the backbone of our defenses

Two schools of thought exist One has unbounded belief in the efficacy of size, the other in the effectiveness of tmy craft which can dart in unseen, present the minimum possible target, and are capable of rapid production in tremendous quantities. Our real defense undoubtedly her between these two extremes

Battleships of 80,000 tons have been suggested Destroyers have trespassed into the realm of the cruiser Cruisers, long held within definite limits by naval treaties, are now proposed of a size that gives them the character of the battle crusers of a few years back but without the strength of such ships Even submarines have been built so large that they carried armaments greater than that of existing crusers Charles Edison, while he was Secretary of the Navy, said



United States cruisers have come in for much criticism during recent years Note square stern

that, personally, it did not terrify him to think of a 75,000-ton ship He expressed his belief that we should provide "crushing weapons with our wealth to protect durwealth"

On the other hand, there are those who claim that one motor torpedo boat, costing in thousands what the battleships costs in millions, can protect us equally as well Given the proper opportunity, one torpedo from such a small craft can effect the same result as the guns of a many-times more costly super-ship

In considering what is best for our own defense, however, it must be borne in mind that our problems are not those of any other nation What may be proper and adequate for others is not necessarily indicative of what we should possess

The majority opinion is still in favor of the battleship, the most heavily armed and armored vessel which designers can produce Battleships must be able to protect themselves against every form of attack and, consequently, the tornedo the mine the shell and the bomb are the weapons against which they gird themselves. At one time they had companion battle cruisers, but England's navy, alone, now contains such vessels as a separate category While the battleship was designed to resist any blow, the battle cruiser was equal in striking power but its higher speed forced a reduction in defen-

sive armament. No ship can be designed to fulfil every requirement of sea fighting, but the battleship, with its relatively slower speed and greater defensive qualities, has heretofore approached closest to the ultimate of ship design.

WHILE we were once conships a speed of 21 knots and designed our battle cruisers for around 33, the new 45,000-ton battleships for our Navy are reported to be designed for the higher speed while mounting the same offensive armament of the 35,000 - ton class of 27 knots Battleships with speeds equal to those of cruisers will almost automatically require that the latter supporting ships be given greater speed if tactical requirements are to be met Thus we sacrifice some

of the primary requirements of the battleship in order to attain the questionable advantage of higher speed

"a twery battleship is to be a battle cruises; then of what is the battle or times; then of what is the battle battle or a max of time to compose the composition of the state of the state of the state of the state of the speed, the heaviest armon, and the greatest striking power, we have arrived nowhere, for such might have been obtained within our with the state of the state of

heavier armor for weight of ma-

Our new \$5,000-ton battleships carry a heaver armanent than any ship in our Navy, have a higher speed and, presumably, are better protected. Ten thousand additional tons on the larger ships have been used to step up speed. Are we headed in the right direction? Would an \$0,000-ton capital ship contain any more legitimate characteristics of the type than we have placed on our \$5,000 tons? These are questions which must be answered.

While we persistently objected to any reduction in the limitation of 10,000 tons which the naval treaties set for cruisers, we were able to provide greater offensive and defensive strength in our ships of this type than any other nation Now, with treaty limitations a thing of the past, we are talking of super-cruisers of 14,000 and even 20,000 tons While our battleships have taken on the characteristics of battle cruisers in the realm of speed, our cruisers are tending toward the battle cruiser type in offensive strength. The clear-cut division between types becomes less noticeable with every new ship designed. This trend indicates that the true purposes of the various types may not be very clearly defined in the minds of our directive personnel

AFTER many years of consistent belief in the need for 10,000-ton cruisers, we recently laid down four 6000-ton vessels of this type and were planning to start a series of 8000-ton craft The Graf Spee battle caused a halt in our plans and the decision to revert to the 10,000-ton type This decision was arrived at even in the face of the fact that one lesson to be drawn from the battle in question was the need for quantity in this type Three British cruisers of small size, light armament, but high speed. forced the heavily armed, but slower, German to its doom. The Graf Spee was surely a hybrid if there ever was one, and a 20,000ton cruiser for our Navy would merely repeat the mistakes of this German predecessor Such types are not for the major sea powers, they are an admission of weakness

If cruisers are tending to infringe on the domain of the capital ship, destroyers, by their ever increasing size, are stepping up toward cruiser category. We have tended to copy the French and Italian navies with



Too big for its class, the French destroyer Cassard approaches cruiser

their special problems, and seem to forget the primary purposes of destroyers Might we not learn a lesson from one day's war news" On a single day, the Allies lost the 1870-ton British Afridi, the 2144ton Polish Grom, and the 2436-ton French Bison While, in size, these vessels approached the cruiser classification, they had only the defensive strength of destrovers, and thus fell ready victims to enemy attack. Our own policy toward large destroyers may perhaps be traced back to the day when we lacked cruisers and were required to use destroyers for cruiser duties. They were unsuited, of course, but our new destroyers seem to have been designed to fulfil those same duties while, actually they should be designed specifically for the tasks expected of the smaller craft

The fleet vacancy left by the increase in size of destroyersprimarily torpedo carriers - has brought forth the motor torpedo boat This move is a clear indication of the realization that the destroyer in its legitimate role has out-grown itself Destroyers must be small enough-within sea-keeping limitations-to dash in to an attack The motor torpedo boat can fulfil this function in narrow waters and within limited ranges It does not appear suitable for a high-seas fleet such as ours, but there is an intermediate craft between the huge destroyers now building and the tiny motor boats with which we are experimenting that should meet the situation

In the last war our destroyers were vessels of 1100 to 1200 tons Now they are of 1630 and 1850 tons Due to engineering and constructional advances, it is firmly be-

heved that the smaller ship of today could be made the equal of the larger vessels of the last war while retaining the desired characteristics of the destroyer. The continuing search for a small craft to fulfill the true functions of the destroyer is evidence we have learned little about the type during the part 20 years.

ANLY in the submarine classification have we shown any reason We have actually reduced the size of submarines in recent years. We experimented with gigantic craft carrying 6-inch guns, but we are now building an in-between type which seems to be successful However, these ships are almost twice as large as those we were building when the last war ended. Two of the latter size, on the other hand, are under construction at presentindicating that we are again inclining to the proper belief that a small submarine, in certain situations, is more suitable. The airplane-carrying submarine, the submarine armed with a 12-inch gun, and other freak types which were experimented with in recent years by several nations have all been abandoned in favor of more generally useful types

Our greatest weakness in submartnes is our almost complete lack of mine-laying vessels of this type. We possess only one submartne mine layer and it is the largest submersible ever built for the American Navy. This is a type which has been tried and found successful, and still we have neglected it It is high time we made up out deficiencies.

No discussion of this nature would be complete without a reference to the anti-aircraft defense of



Courtey Jane's Fighting Ships' World's largest submarine: the French Surcouf. Submerged displacement 4300 tons. Carries two 8-inch guns, besides a number of smaller ones plus many torpedo tubes

ships and fleets. Mr Edison has stated that airplanes have a temporary advantage over ships under modern conditions of warfare Even if this be true, that advantage can he overcome by proper defense Protection must be given the gun crews on all types of ships. In this respect, we are now progressing along the right course Even our destroyers now have at least some of their guns mounted behind shields The Wasp, however, our latest aircraft carrier, was commissioned with her anti-aircraft guns fully exposed to attack Since attack from the air is precisely the moment when anti-aircraft weapons should be in use, greater protection must be given their crews The belief that the top-sides of battleships could be shot away and the ship still operated is no longer completely true since the elimination of anti-aircraft weapons might leave the vessel open to fatal damage from attacking aviation

While additional anti-aucraft defense in the form of protected guns must be provided on all vessels, thought should also be given to the provision of fighting planes as apart of the avaition complements of the larger ships Ships operating alone or in small detailments must be provided with their own means of defense against aerial attack.

We are now contemplating the conversion of old destroyers into special anti-aircraft vessels (the British have had them for some time). Any such addition to a fleet's ability to defend itself against at-tack from the air must be encouraged, but reliance upon special oversels for such protection might find the necessary craft in the wrong positions and leave a fleet open to serious damage. The air-craft defense of ships had best be concentrated on the ships themselves.

Even considering these critical remarks, we may rest content that our ships, generally, are today the equals, if not superiors, of similar ships in any navy Our desire should be to keep them to their present high standard Adequate defense cannot be obtained by the adoption of freak types A wellrounded defense consisting of tried types is our salvation. We cannot expect to build the ship in which the characteristics of every type is We must revert to a embodied policy of clear-cut divisions between types, giving each the maximum striking and defensive strength suitable to it We must limit each ship to reasonable size in order to avoid too great a loss to the whole when any one is destroyed In short, we must continue the beliefs of earlier days and avoid, by all means, any tendency toward freakish types, for they have been found wanting in the past and have always been a sign of a weaker naval power We cannot afford to be considered that.

Panzer Divisionen. Since publication of that article, the War Department has announced adoption of tank tactics similar to those of the Germans and the creation of an armored corps of two divisions on an experimental basis All tanks and other vehicles formally assigned to the Infantry and cavalry will be concentrated in the new corps which will consist of more than 18,000 officers and men The corps will be equipped with 1400 tanks, 600 tanks, 600 with 1400 tanks, 600 artillery pieces, and more than 13,000 auto-matic and semi-auto-matic and semi-auto-matic rifles, according to reports. This new unit is made possible by a recent appropriation which included provisions for procurement of 3000 tanks for the army. Only about 500 are available at present.

This new, fully mechanized corps will be capable of striking at speeds of 50 miles per hour. It will probably be equipped mainly, according to official comment, with a number of heavy units about twice the weight of present medium tanks. Our Army does not use the 70 or 50-ton monsters such as those in the German and French Armies, and at present there is no suggestion that such tanks might be built by the United States.

"NORTH CAROLINA"

THE photograph below shows the launching of the North Carolina. the second of two battleships launched this year, the two marking the first expansion in our battleship force since 1920 The North Carolina will be of 35,000 tons displacement and will carry nine 16inch guns, twelve 5-inch, 51 caliber guns, and eight 5-inch anti-aircraft guns, and four airplanes and two catapults She will be approximately 35 percent welded instead of riveted, thus saving weight which can be utilized in other ways. Her cost will be an estimated \$65,000,000.



Launching the North Carolina, second of two launched in 1946

U. S. TANKS

New Armored Corps Modelled After Those of Germany

READERS learned from Captain McInerney's article in the August Scientific American that the tank set-up of the American Army differed greatly from that of the destructively successful German

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"ALL-AMERICAN" WAR

ROPAGANDA IS a wondrous thing It has made of Hitler, according to the welcoming phrases of German newspapers when he recently returned from the Battle of France "A Genius for Commanding," "The Lord of Battle," "Leader from Darkness to Light." It has made of him a legendary hero of the proportions of a Napoleon and a Caesar rolled into one

It will, however, help the logical processes of American thinking in developing our national defenses if we remember that Hitler is but a man. Hitler does not direct the tactics of the German Army. Men trained in the science of war do the commanding It is even doubted in some quarters whether it is his decision which unleashes the might of the Nazi columns according to the plans worked out by his military chief-tains. Theirs is the knowledge of war, theirs must also be the knowledge of precise timing.

But he has brought to war so many new weapons and methods? Has he? Definitely not The blitzkrieg is about as old as war, but Sherman's march to the sea is sufficient as an example. Only the speed is new. Tanks. in large numbers? Hannibal had his herds of fighting. warrior-carrying elephants And the tank is but a British adaptation of the commercial tractor developed by Americans Airplanes are, of course, from an American invention Dive-bombing is wholly American Parachute troops? One radio commentator, whose authority we can trust, claims priority for the American Army in that tactic --- even over the muchpublicized Russian parachute experiments But, we hear, the Germans are geniuses for industrial efficiency Are they? They have but followed American technique for industrial planning and organization - a technique in which we lead the world Indeed, mass production, as a system, was invented by an American Eli Whitney, of cotton gin fame

"Plan" is the whole secret of German success in war—plan, organization, co-ordination And don't forget starvation—the tightened belts that made possible their tools of war. Hitler is not the secret He is only the figurehead, the angel with wings of propaganda and feet of clay It is German planning and doing and sacrificing that the world must beat So far as American national defense is concerned, we can beat it hands down—and a dozen times over Are we going to do it, or sit back, play politics, and say "What's the use? Hittler is invincible";—P. D. M.

HOT OR COLD

Will hot water freeze faster than cold water? An excerpt from Science, printed on the "Browsing With The Editor" page in our August issue, says "No" This answer to an age-old question promises to stir up one of those minor controversies that make interesting speculation.

Offhand, logic would plainly indicate that cold water should freeze faster than hot; both must be cooled to zero, centigrade, and logic dictates that the temperature differential is such that cold water will reach this point long before hot water. But may not this be one of those occasions in which logic is so plain as to lead the logician astray?

Such may be the case. Conflicting experimental evidence has been produced to answer the question both. ways: hot water freezes first; cold water freezes first



Plumbers tells us that the pipes carrying hot water in homes will burst (but not necessarily freeze) before the cold water pipes, when exposed to low temperatures over long periods of time But it has been rather definitely settled that this phenomenon involves the question of differences in quantity of dissolved air in the two systems

What are the facts when the hot and the cold water are subjected to low temperatures under identical and controlled conditions? The family refrigerator, mixtures of ice and salt, the cold-storage box of the neighborhood butcher—all offer experimental possibilities

No world-shaking revelations are promised by the answer to the question, but the editor will entertain the thought of publishing submitted results of controlled experiments made by readers. Here is a question that should be answered once and for all, if for no other reason than to prove or disprove the soundness of logic applied to a simple problem—A P P

LIGHT

"P EOPLE'S eyes never were intended to stand the more and more powerful illumination they are using today."

"You've complained of tired eyes, yet now you install a big 100-watt lamp only 18 inches or so above your desk to tire them faster. It isn't intelligent."

The desk really did seem pretty bright with the new lamp in its deep reflector, and it kept on worrying office callers "Why, that's brighter than the sun," they said

One day in May, when the sun crept high enough in the sky to shoot a brief nonday pencil of light down through one of New York's canyons and directly on the desk, overlapping part of the lamp's illumination with a sharp demarcated area of its own, the facts came vividly and literally to light The lamp-lighted area, considered too bright by callers, now seemed only dusky by comparison It looked like deep shadow.

The sun's light approaches 10,000 foot-candles but take 5000 as something like the natural outdoor level under which human eyes evolved For regular reading, it is, however, pretty strong

The science of seeing, according to its ablest authority, Dr M Luckiesh, Director of General Electric's Lighting Research Laboratory, reveals evidence that you could read this printed page easiest at 100 to 1000 foot-candles. As a temporary compromise it recommends at least 50 to 100 for difficult reading and 20 to 50 for ordinary reading.

It's easy to underdo working illumination — hard to overdo it. On lighting, the world is steadily learning a new set of values — higher Ultimately, they'll go much higher, in accord with good science —A G. I.

Mud. Concrete, and Oil

Drilling Mud, Treated Like a Favorite Child, Makes Possible Wells Miles Deep

ANDREW R. BOONE

In the summer of 1858, Col Edward L Diake, a former nailroad conductor willing to gamble on a strange new venture, started the first test bit into the earth at Titusville, Pennsylvania He drove down a 36-foot casing and, using a wheezy six-horsepower engine, drilled inside the pipe At a depth of 69½ feet, the Colonel discovered oil for the first time in history, and shortly thereafter sold his output at 60 cents a gallon

Across the continent in sunbaked San Joaquin valley, near Wasco, California, a diminutive



Checking specific gravity of mud returned from circulation

tool pusher named Louie Hopkins recently completed, for the Continential Oil Co., his ninth hole deeper than 13,000 feet. One of the wells drilled by Hopkins, the KCL-A2, hit bottom at the world's record deepth of 15,004 feet, 215 times deeper than Drake's discovery Whereas Drake's "Folly." as envious diehards dubbed the first exploration 82 years ago, barely pricked the earth's surface, in nine tries Hopkins has directed the bit downward a total of some 22 miles.

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upward more than 2½ miles Instead of 60 cents a gallon, this oil, brought in at a cost of \$300,000, fetches on the current market less than the small sum of three cents a gallon

Diamond-tough drilling steels, storers ranging from bomb-like structures to rock smashers consisting of cones which rotate within revolving bits, new and more powerful steam engines capable of shoving mid down inside the drill pipe and thousands of feet upward again, basket-like cement plugs and pipe whose threads will not pull apart under the tremendous weight of 500 tons, make it possible to reach deep sands and bring their loads of black gold into production

much besters and cement mixers make possible fast drilling and completion of wells uncontaminated by water and sand On every deep-test rig you'll find a mud engineer on the job constantly. Drilling mud is a mixture of water and some powdery non-metallic mineral, such as gypsum, often fortified by several chemicals, including the chestnut extract and quebrach It is pumped down inside the drill pipe, out through the bit and up between

the pipe and the walls of the hole It must keep moving, carrying up cuttings, lubricating the pipe, and preventing cave-ins, otherwise the drill pipe will stick and the hole be lost

be lost thopkins knows mud and treats it like a favorite child, for this sticky substance has given him an enviable record He starts it down weighing exactly 95 pounds per cubic foot After it has mushed through deep shale hot enough to boil water and has picked up a load of gas, he runs it through a series of paddles operating in vacuum, and returns it to a nearby put to await the next trip down The agitator removes the gas and reconditions the mud

When at last the bit penetrates oil sand, cement men drive up with their mixers and prepare to wall off any water which may leak down



Expanding brass baskets keep concrete from below the casing



When concreting a deep oil well, men must work at top speed. The mix must reach bottom and return outside the casing before it begins to set



The wooden blocks that are used when concreting a well

from upper formations. Two plugs and an expanding basket make possible effective shut - offs The backet is lowered to the bottom and expands when concrete begins to press against its insides This prevents the mix from moving down into the oil formation A wooden block containing a hole through which the concrete may escape slides down the casing, following the basket to bottom After the block goes a column of concrete, followed by an upper block which separates the concrete and the mud which powerful pumps force down against the upper block

Not long ago a cement crew slashed open 1400 sacks and forced the mix downward, cementing a California well 11,000 feet deep in 30 minutes, 30 seconds That was one record "Shucks," commented the foreman of another crew next day, "we placed 2000 sacks in 24 minutes, 40 seconds" What he meant was, 50 workmen had prepared the mix, and two batteries of pumps had forced the gray slush down more than two miles and up 4200 feet between the casing and. rocky walls of the hole in that time. Meanwhile, to prevent a jam, the cables had been picking up and lowering 425,700 pounds of drill pipe in 15-foot steps, as easily as you lift a kitchen chair.

Wells four miles deep are a definite possibility during the next few years May they go on down farther to unexplored horizons, tapping little-known sediments that were laid down in remote geologic ages?

Colonel Drake little dreamed that the 25-barrel production would multiply by millions. He batted 1000 by bringing in a wildcat when friends and relatives hooted at his wild, dreams. Louie Hopkins batted.

666 on his nine deepest wells, but the six flowing today came in with 440 times more oil than the colnoel found Louie is ready to try his luck with a four-mile hole All he wants is a good head of steam, enough pipe to reach bottom and a mixture of mud and chemicals which he knows from experience will keep the rig turning until he gets there

Under Mobile River

Vehicular Tunnel Built On Land, Floated Into Place, Shows Engineering Advances

R. G. SKERRETT

Mosiles, Alabama, on the much traveled old Spanish Trail, has built, at a cost of \$4,000,000, a different type of subaqueous tunnel for the convenence of automotive traftic. The tunnel will shorten the east and west route by 7½ miles, and will materially reduce heavy traffic congestion.

Mobile is at the mouth of Mobile River and at the head of Mobile Bay at a point 30 miles inland and north of the Gulf of Mexico. The city is Alabama's historic and only seaport It is on the west bank of the stream, opposite Blakely leland.

Work on the Bankhead Tunnel, as the river underpass is called, was started in July of last year. It links Mobile with Blakely Island and connects with a 10½-mile cause-

way extending eastward from the island and spanning several narrow water gaps

The under-water sections of the tunnel were built at a local shipvard, launched one by one towed to a nearby slip on the west side of Blakely Island, and there brought to a stage of near completion before being moved to and sunk in a deep trench dug in the live bed Five of the seven sections are each 298 feet long, and the two other sections are each 225 feet long The under-river structure has a total length of 2000 feet. and near each shoreward end there is a transition section which connects with a rectangular or box-like section of the tunnel At the Mobile end, an open ramp approach extends downward from the street level to the portal of the western section On Blakely Island, the steel box section runs right up to



Partly finished steel framework of an under-river section. Steel plating covered the outer octagonal ribs, and concrete filled the space thus made



The top of the outer shell of this tube at Blakeley Island is open so that workmen may install wiring conduits, pour the concrete, and so forth

the ground surface, and is equipped with a steel gate which may be closed, in time of hurricanes, against water piled up on the island The Bankhead tunnel has a total length of nearly 3390 feet between grade levels, and its roadway is 21 feet wide for two traffic lanes — eastbound and westbound

The Bankhead Tunnel is similar in principle to the Detroit Tunnel, built in 1930, but differs in a number of particulars which represent engineering advances Each tubular section of the under-river divisions is made up of an inner steel cylinder 30 feet in diameter surrounded by an octagonal steel tube that has a minimum diameter of 34 feet. The two concentric tubes were tied together by equidistant radial ribs, and the spaces between the two tubes filled with concrete before being finally sunk in the trench and covered. The inner tube of each section is lined with reinforced concrete not less than 18 inches thick The top of the tunnel, in mid-channel, is about 46 feet below the level of mean low water

Each end of each tube was sealed temporarily with a water-tight steel bulkhead before launching, and concrete was poured into the inter-tubular space to a height of 10 feet to give each section stability when it was first launched Steelwork was put together by welding, and, before launching, each tube was coated with soapy water and subjected to internal air pressure—any leak promptly blew tell-tale bubbles

At Blakely Island, openings were cut in the top plates of each inner tube to give temporary access to the inside of a section so workmen could place the concrete lining, the conduits for power, lighting, and telephone circuits, the roadway slabs and the ventilating duct beneath the mid-section roadway for a distance of 400 feet That done, the access hatchways were sealed, and the sections, starting at Blakely Island, were floated to the trench and sunk

At the trench, the last of the concrete was poured into the spaces between the inner and outer shells until a section lost its buoyancy It was held suspended in a sling and lowered deliberately Succeeding sections were brought together by pulling the newly laid section, with ratchet turnbuckles. snugly against one already in-stalled A projecting ring on one fitted into an annular recess filled with a rubberized gasket on the other Divers did this work Later, the joint was covered on the outside with concrete poured underwater Finally, when bulkheads were cut away, adjacent inner tubes were tied together by a welded ring of steel

One ventulation building, on Blakely Island, is equipped with exhaust fans only which suck vitiated air into ports on both sides of the roadway level for 400 feet in the mid-section of the river part. No fresh air is blown into the tunnel, but the action of the fans at the low point is counted upon to draw fresh are inward and downward from both portals and mainan proper circulation. This arrangement is based upon experimental work of the U. S. Bureau

of Mines An unusual feature of the illumination is that, while lights are arranged to give proper illumination at all points in the tunnel, special additional lights are installed near each portal. These latter lights burn only during the day, their purpose being to make the transition more gradual for the eyes of the driver as he enters from the strong outside sunlight.

ROAD PROTECTION Bags of Green Concrete

Laid as Rip-rap

One of the most troublesome problems of road building and maintenance is that of protecting slopes against crossion. Where run-off is rapid and in large volume, it is rapid and in large volume, it is practically impossible to start sufficient plant growth to root the soil in place in such cases, engineers often resort to use of rock run-rap in California, on some sections of highway, engineers are making ther "stones" and, in addition, are making them so that they dovetail

Because of bad wash-outs along highway slopes, and particularly where the water action is of such tremendous power that boulders five to eight feet in diameter are carried away, the slopes are being lined with bags of concrete. As an accompanying picture shows, these bags are filled with green concrete and then laid on the embankment in even, horizontal rows. In their damp state, the filled bags press down, one layer upon the other, so that when they harden, they fit into and hold each other tightly The finished slope presents a pleasing appearance that could never be attained by use of rough stones

Engineers are watching the results with this form of slope protection, for it is believed that it will be superior to ordinary rip-rap



Man-made "stones" protect road

IDAHO WHITE PINE SUPPLY—White pine is being drained from the famous Idaho forest lands two and a quarter times faster than Neture restores it By replanting now, stopping fires, and cutting timber scennifically, we can make restoration balance use in five dicades—"Forest Increment in North Idaho," U. S. Forest Survey Release No. 18

HIT BY CARS—In one group of pedestgian fatalities caused by automobiles in Wisconsun, 81 percent of the victims were unfamiliar with the operation of the vehicle which caused their deaths Doubtless this condition is general, for Connecticut reports 94 percent of pedestrian fatalities were people not hiensed to drive—Highway Research Abstracts, July, 1940

PLANES BY THE POUND—The thousands of warplanes Uncle Sam is ordering for defense will cost about \$7.05 at pound. The announced goal of \$0,000 a year means the production of over half a billion pounds of airplanes, engines, and propellers—Science Parde, July 13, 1940

LIGHT AND ACCIDENTS—The National Safety Council estimates that 5 percent of industrial accidents—in other words, \$75,000,000 worth—are caused by poor light—Industrial Bulletin of Arthur D Little Inc. Number 153

RENTED AIR CONDITIONING—An air conditioning system that can be reited by the day or conting, along with the auditorium it serves, has been installed in the Jewish Community Center in Detroit Lee is used to provide cooling during periodic uses of the system.—Refrigeration and Air Conditioning, June, 1940.

FURNACE RECORD —A blast furnace of the Otis Steel Company has probably achieved the record of operating for the longest period of uninterrupted use ever obtained on a single blast furnace lining From May 1930 to May 1940 it operated continuously without being blown out, producing in that 10 years 1,735,500 gross tons —Hill & Knowlton notes, May 17, 1945.

STRAIGHT ROAD —An Italian "autostrad" across North Africa has one stretch 400 miles long without a sharp turn. —W C Lowdermilk, American Forests, July, 1940

SHIP UNLOADING—Ships that unload themselves with the aid of belt conveyors, which have been in use for more than 20 years on the Great Lakes, are beginning to win acceptance on the Atlantic Coast, where the second oceangoing vessel thus equipped has recently been put into service—Oil-Power, July, 1940

FOREST FIRES—It is not improbable that, in the daylight hours, an average of one forest fire is set every two minutes in the United States—probably every minute during the vacation months This is an indictiment of people who are careless in the use of tobscore, because that is the cause of most of our forest fires—News, New York State College of Forestry.

LOCOMOTIVES—The American railroads have 46,544 locomotives, of which number 45,210 are operated by steam, 882 by electricity and 452 by gasoline or oil—Association of American Railroads.

CONSERVATION FOR DEFENSE.—Conservation today takes on new importance because of the urgany of national defense. A country's natural resources sustain its defense and combatant power. This is true of forests no less than oil and other natural resources.—American Forests, July, 1940

ARTIFICIAL RUBBER COST.—The cheapest commercial "synthetic" rubber today costs about twice as much as the



natural product —Lawrence A Wood, Ph D, Circular C427, National Bureau of Standards

SILICOSIS—During 1939, 91 miners were certified to have died of silicosis and 355 certified to have been disabled by the disease in the South Wales coalfield—Nature (Lundon), June 22, 1840

AIRPORT PAVING —The new Washington, D. C., arrport will have a total asphalted area, including four huge runways, pirking areas, and roads, equivalent to 83 miles of highway 18 feet wide. What is purported to be the world's largest airport, in NewYoundland, has the equivalent of 116 miles of 18-foot asphalted paving —American Petroleum Institute, July 7, 1840.

ON THE 'PHONE—Americans, person for person, telephone 14 times more often than the rest of the world Furthermore, this country has about half the world's telephones, and makes something like 1000 calls a second—Telephone News Bulletin, May, 1940

INDUSTRIAL ALCOHOL—Approximately 198,467,000 pounds of corn and 202,631,000 gallons of molasses are annually manufactured into industrial alcohol—Monsanto Magazine, May, 1940.

SHOCKING EELS—An electric eel may discharge as much as 1000 wasts of electricity at a voltage of 600 This discharge is at the frequency of 200 or 300 times a second—The Lamp (Standard Oil Company of New Jersey), April 1940

MORE SOYBEANS—Soybean production in the United States has multiplied 22 times in the past 15 years, 17 times in the past six years—American Chemical Society.

BULLS SEE NO RED—The popular idea that bulls fight when they see red has long been exploded. The bulls are color-blind. It is the movement, not the color, that infuriates—Science Parade, May 6, 1940.

EXPLOSIVES BY RAIL.—Railroads of the United States and Canada in the past 13 years have transported billions of pounds of high explosives, including dynamite, black and smokeless powder and explosive ammunition, without accident, death, or injury—Association of American Railroads

STOP AND GO —A mere 15 years ago, a green light on Fifth Avenue, New York City, meant "stop," yellow meant "go," and red meant "caution"—Science Parade, May 4, 1440

AUTOMOBILE EXHAUSTS.—Gasoline burning in automobiles produces enough carbon dioxide in a year to make 160,000,000 tons of "dry ice"—The Lamp (Standard Oil Company of New Jersey), April 1940.

Helicopters

Rotating-Wing Aircraft Exhibit Desirable Characteristics for National Defense

ALEXANDER KLEMIN

Aviation Editor, Scientific American. In charge Daniel Guggenheim School of Aeronautics, New York University

HE writer of these notes has been criticized for allowing the school of aeronautics with which he is associated to give real attention to rotating-wing aircraft at a time when the airplane is so important as a means of national defense! But is it not possible that rotary-wing aircraft-autogiro or helicopter-will also serve most usefully in national defense? At least a wise and experienced engineer-Igor Sikorsky-is of this opinion, and voiced his views strongly and persuasively at a recent meeting of the Society of Automotive Engineers

The airplane by the nature of its design, will always be faster than the helicopter—say 500 miles an hour against a potential 300 miles an hour against a potential 300 miles an hour for the rotating—wing craft However, for defensive military purposes the helicopter can perform in a number of ways which are impossible for the airplane Let us quote Mr Sikorsky

"For example, to interpose an effective defense against bombers or dive bombers, the helicopter seems to me to be ideal. It can stand still in the air, thus affording a stable gun emplacement from which the gunner can await the moment-which must come either in altitude bombing or dive bombing-when the bomber ceases all zig-zag maneuvering and flies a straight line for its quarry Then the bomber is comparatively easy to hit The helicopter, of course, can easily have altitude performance up to 15,000 feet or more and can carry large-caliber machine guns or even cannon

The helicopter can also remain poised above strategic spots It can evacuate the wounded, particularly at night 18 y descending within reach of the ground to pick up man and litter, the helicopter can act as a perfect air ambulance. Again, said Mr Sikorsky, "once launched from a battleship or cruiser the airplane can be recovered only by

alighting on the sea, if it is smooth enough, while the craft is lifted aboard Obviously, in battle, major units cannot stop to pick up aircraft even if conditions of wind and water make this possible. The helicopter however, would require only a platform or deck space of about 40 feet square from which to take off and on which to land. It could follow every dodging movement of the surface craft, flying backwards, sideways or forward at will and always itself afford a steady firing point for its defensive guns

Landing gear for the helicopter would be rubber bags rather than wheels and on these bags the machine could use land, water, ice, snow, a vessel, or a building for a take-off or landing Pilots could be trained to fly a helicopter with relative ease

Mr Sikorsky has made a logical and strong plea which should not be forgotten

AIRSHIPS

Still Hold Possibilities for Military Purposes

EXERAL opinion, public and aeronautical, is that the airship is dead,
that it is too slow and vulnerable
for fighting purposes, too slow for
transoceanic passenger work when
the Clippers can fly three times as
fast The Navy Department does
not agree with this view A special
board on the lighter-than-air
stutation reports to the effect that

in spite of all disasters and speed inferiority, relatively small rigid airships should be built

airships should be out:
With its ability to carry airplanes, the rigid airship can be
best compared with a crusser or an
airplane carrier. The cruser is
capable of about 30 knots sustained
speech of three days the modern
agent of the control of the control
days. The airship can be conceived
as an airplane-carrier immune to
mines, torpedoes, and submarines,
which could well proceed overseas
and, lying well off an enemy coast,
launch a successful airplane airtack. The airship would be most
useful in long range observation,
scouting, recomissaine

Of course, we could cite many arguments against further airship effort But to build a small durigible of 3,000,000 cubic-feet capacity, at a cost of \$3,500,000 for training of personnel and experimental purposes is an idea worth considering—A K

ENGINE

"Submerged" Design Increases Flying Efficiency

As the drag of landing gear, external supports, and even of the fuselage is reduced, and the airplane approaches the ideal of the "flying wing," it becomes more and more important to eliminate the

drag of exposed engine nacelles



Two views of the "submerged" Lycoming engine for aircraft



Designers advocate the "submerged" engine—that is, an engine engine—that is, an engine which is enclosed completely within the wing—and argue that the hidden engine will decresse fuel to consumption and increase speed Now, the Lycoming engine division of Aviation Manufacturing Corporation has produced a novel "fat" engine which should meet with immediate application in our military and naval surreaf.

The Lycoming flat engine is illustrated in two of our photographs There are 12 cylinders, six on each side of the crankshaft The over-all height is only 37 inches compared with the 49- to 54-inch diameter of the conventional radial air-cooled engine. The low frontal area and low height makes it perfectly feasible to house the engine completely within the wing Of course, the problem of airplane balance has to be met, since the weight of the radial engine is located oute far forward, relative to the rest of the airplane, but designers will meet the situation Also, the flat engine, being liquid cooled, has to have a radiator But the radiator can be filled with Prestone which operates at a much higher temperature than water. and hence the radiator can be quite small Further, the radiator can be ducted or streamlined partially in the under side of the wing

Altogether this is a praiseworthy and promising development, which comes at the right time in the national defense emergency —A K

RIVETS

Salvaging Methods Cut Costs in Airplane Assembly

in Airplane Assembly

PRODUCTION engineers of the Glenn L Martin Aircraft Company long ago discovered that it was cheaper to let he the rivets dropped accidentally on the airplane assembly floor than to have operators take time out to pick them up. The riveter's time is valuable, a skilled worker is expected to drive 1000 rivets a day Nevertheless, dropped





Side view of the Ercoupe, practically spin-proof

rivets represented a real problem, since a pound of aluminum rivets costs approximately one dollar, and some 60 pounds of the rivets were swept up every day. A team of boys used to sort out the rivets by hand, but it was slow and un-economical work to separate the round-head and flat-headed rivets and those of varying lengths and diameters.

Now the tool designers have developed a rapid, semi-automatic process An electro-magnet is passed over the floor sweepings. snatching up extraneous steel and iron material. The residue is chiefly rivets of some 150 different kinds. Next, a series of sifters sort out the rivets for diameter in much the same way as gravel is graded Then a mechanical device separates the livets for length, the rivets travel around the perimeter of a wheel until they are knocked off by the length gages To expedite



Steps in salvaging rivets. Lower left: Sorting for diameter with sifter. Above: Sorting for length. Below. Separating round-heads from fiat-heads



the process further, a little handoperated machine has been developed which serves to separate round-heads from flat-heads The round heads drop out first, the flat heads next.

Obviously, our tool designers will play a not insignificant part in the national defense effort

UNCONVENTIONAL

Combined Features Make Spin-Proof Airplane

We have for several years been of the opinion that all the aerodynamic factors required to give us a spin-proof airplane were already available A new, somewhat unconventional airplane, the Ercoupe, seems to come near to this safety requirement. At least no inspector of the Civil Aeronautics Authority has been able to spin the new ma-

While the wing of the Ercoupe is thick throughout, and is externally unbraced, it is rectangular in plan form - there is no taper With a sharply tapered wing, the tips stall first With a rectangular wing it is the center section which stalls first Moreover, the leading edge of the center section is brought down to a sharp V, and this again tends to make the center stall first. With the center stalling first, there is no tendency to fall off on one wing an initial step in the spin Again. the two rudders are quite clear of the fuselage, being carried at the ends of the horizontal tail surface Therefore, at high angles of attack, with the nose pulled up sharply, the vertical surfaces are not blanketed in any way, and retain their full effectiveness

But there is still another factor which is a spin safeguard for the novice pilot. The upward travel of the elevator, which of course tends to raise the nose of the aircraft, is strictly limited. Thus the novice cannot readily put the machine in a stalled attitude—A. K.

No Short-Cut Horticulture

Plant Growth Chemicals Require Painstaking Care, Promise Significant Results

PHILIP H. SMITH

THERE is a widespread impression that chemistry is leading horticulture and agriculture into a new era, marked by the abolition of the hoe, the wheelbarrow, and the spraygun Given a pill or a powder and the novice will become an expert overnight, flowers and vegetables will increase from half-dollar to dinner plate size, and meals will be plucked from freescapes But why go on?—your imagination is as good as mine

Plant chemicals can accomplish wonders Some make possible plant growth in water solutions, quite remote from soil, some will stimulate root growth on cuttings, others will make fruit form without pollination. There is one chemical which induces root growth on backward plants, and another which enables the hybridizer to create new varieties which nature might never get around to do

In reporting these wonders, scientists have given fact, not fancy, and no further confirmation is needed All fact can be visually substantiated in this or that laboratory. But the layman asks the significance of all this to him "Can I," he says, "get results with the chemicals" Is water culture commercially feasible? Can grandmats begons be reproduced by a tyro?"

At the risk of posing as an old meany, I must declare that horticulture is about where it was before the advent of these chemicals, except that there are probably more bugs in the world But the use of chemicals introduces something new, promising, and anchored in scientific fact. It offers means to experimentation and acquisition of knowledge about plants, it promises little ease and less profit.

Gardening without soil, variously called tank culture, tray-farming, and hydroponics, has developed fast and in a number of directions. There is now great variety in form and composition of tanks, in the constituents of the

nutrient, and in the method of feeding. Experimenters seem to favor the system known as gravel and cinder culture. Here, the plants actually grow in gravel or cinders and are fed periodically by sub-irrigation.

Successful tank culture calls for sunlight and air. These elements are quite as essential to growth as in soil culture. Thus an immediate



Colchicine doubled the chromosomes in this peach tree at Beltsville, Maryland

requirement is outdoor or greenhouse location, and whatever the solution fed, it must be properly aerated Temperature, too, is important and for best results there must be a carefully controlled differential between air and solution temperatures and between day and night temperatures. Once the general procedure has been determined, there remain such technical problems as: character of water used, acidity of the solution, proper replenishment of salts in the nutrient to replace unequal consumption by the plants and losses by precipitation, toxic effect of tanks and beds, and the precise timing of every operation. Gravel and cinder culture is recommended as having these advantages elimination of cultivation, watering, weeding, fertilizing, soil changes, and many soil-borne diseases, control of the type of growth, and virtually automatic operation. However, these advantages must be weighed against the cares outlined in the foregoing paragraph to determine the net gain, even assuming profitable operation. Some people preferscratching the soil to reading thermometers, minding valves, or keeping accurate records

The number of persons operating commercially successful hydroponic farms can be counted on your fingers, although the number will doubtless increase. It is a highly exacting and specialized perform-

ance and at this stage its costs are such as to limit its practical possibilities to areas where out-of-season crops demand premium prices, where there is lack of good soil, or where the soil is so poor that it takes heavy outlay to keep it at par Certain geographical sections are unsuted to hydroponics because in off-season, when crops are wanted, the sunlight is inadeouate.

DEVOTEES of hydroponics declare that tomatoes have been raised successfully in water solution and the fruit so f superior quality. This is true. But it has not been proved definitely that the same care and control applied to soil culture would not produce a comparable crop The successful hy-

droponttan is a man who has acquired an intimate knowledge of the plant he grows—its habits and climatic needs, its mode of propagation, and the control of pests and diseases—usually from previous soil culture.

The ununitated believe the critical factor in hydropomics to be the chemical formula, but this is secondary to the facts just mentioned. The problem of what to feed has been pretty well solved and formulated chemicals can be bought in the market. Of the several formulas in use, there is little variation. A good all-around composition calls for potassium

phosphate (monobasic), potasslum nitrate, calcium nitrate, and magnesium sulfate, to which is added munite amounts of iron, boron, manganese, zinc, and copper, Waters differ greatly as between geographic areas, hence the experimenter must modify basic solutions to obtain proper salt content if he would obtain zood results

Far more interesting than the water-solution chemicals are the hormone-like substances which modify or regulate plant growth These chemicals are called "hormone-like" because they are substances thought to act like unknown plant hormones They are not laboratory syntheses as is widely believed. As a matter of fact, those which induce root growth have never been found in plant life There are some 50 of them known to scientists as being capable of playing tricks on plants, but there are only three in common use today These are naphthalenaacetic, indoleacetic, and indolebutyric acids Of these, the last named has proved most satisfactory because it is effective over a wider range of concentrations

THE root-inducing power of these chemicals is unquestionable. If they are applied to leaves or flower stalks, for example, roots will grow from the places touched. The immediate, practical value of these substances is in the propagation of plants and shrubs from cuttings. either to hasten the process of root formation or to make roots grow on cuttings of species ordinarily non-rooting Common practice is to dip the basal end of cutting in a solution of indolebutyric acid for 24 hours, or to dust with a powder composed of hormone and talc; otherwise propagation technique remains unchanged

It would be a serious mistake to assume that these substances are infallible because they have had certain unparalleled success Combined with the capacity to induce roots, is a like power to retard growth and inhibit bud formation Sometime the technique may be worked out to take advantage of these added powers, but at present they impose care lest too strong'a concentration kill the entire cutting. Root inducers do not eliminate the seasonal factor in propagation, nor will all species respond to their coaxing. Every variety of plant or shrub has its own peculiarities which must be given con-sideration. In general, leafy cuttings respond much better than hardwood cuttings, whatever the species

The hormone-like substances can do more than induce root growth Artificial stimulation of fruit without political stimulation of fruit without pollination—is one of fruit without pollination—is one of the achievements. The classic example is the manufacture of red betries on the American holly When the male tree is too far from the female tree to permit transfer of pollen, no berries are formed from the female flower. Here



One way of drugging a plant: treating seeds with colchicine

naphthaleneacetic acid comes to the rescue Spraying the flowers with a solution of the acid will cause berries to be formed They will be seedless, but who cares at Christmas The practical value of this treatment is another story. The acid costs more per ounce than gold. and the most economical solution to the production of red berries would seem to be to plant more male bushes However, this type of experiment hints at the future production of seedless fruits and vegetables-seedless tomatoes, for example, for persons allergic to tomato seeds

Experimenters report success in the use of these chemicals for restoring the viability of seed. This would be a boon to seedsmen, not to mention the backyard gardener who invariably ends the season with a surplus of packaged seeds and hesitates to use them the following year lest it spell crop failure. Other claims for these hormone-like substances are: acceleration of seed germination, increase of corp yield, inhibiting of fungi growth, particularly of fungi growth, particularly of warety, increase of



Simpler than soaking: painting slit twig-tip with colchicine

callus formation in grafting, the speeding up of bulb development, and the building of better lawn turf. However, no use of chemicals has reached the "simply add hot water and serve" stage, and until the amateur can maintain a cheerful attitude in the face of failure, he would do well to await more conclusive proof of these last mentioned wonders.

Seed catalog fans have been given a genuine thrill this year by the announcement of a chemically-produced variety of marigold. This is the first commercial offering arriving from the use of the powerful drug colchicine.

The discovery that colchicine can retard cell division and multiply the number of chromosomes in a plant has occasioned wide speculation. Are we about to see the family-sized vegetable? Is the genus of the laboratory about to produce a Frankenstein monster? Well, there are limits to what colchicine will do If breeding experiments begin with a squash, they end with noe, although the new squash may be bigger and have qualities assembled to the breeder's taste

Colchicine does put * very valuable tool in the hands of hybridizers and the result will most certainly be a quickening of new variety origination. What the drug really does is accelerate the natural process of breeding, to accomplish in comparatively short time what nature might take generations to do if, and when, she got around to

A stumbling block to breeding has been the difficulty in producing hybrids that are fertile, hence capable of reproduction. Sterility



Hard-to-root holly. An example of chemically induced roots

is the rule, fertility the exception or the happy accident. These accidents are produced in nature without regard for time, and man's only improvement over the natural process has been to multiply the chances of an accident by mass planting and crossing Colchicine, while not infallible, increases the number of chromosomes in many plants-doubling, tripling, quadrupling, dropping one chromosome off or adding one-to produce fertile hybrids Thus the progeny, in turn, become capable of breeding, and the work of crossing, re-crossing, and back-crossing can proceed apace until the desired qualities have been assembled within a single plant

It is conceivable that hybridizers may be able to use chemicals on annuals and give them a perennial This would eliminate yearly planting. It might be that perennials could be endowed with qualities found only in annuals There can be breeding to give plants resistance to diseases. This last has been accomplished already by older methods of trial and error but now it can be done with more speed and certainty Perhaps colchicine will produce results which never could come about by the happy accident system If proves to be true, the potentialities of the drug treatment can hardly be estimated at this stage of development

The most recent chemical to be put before the public is Vitamin B-sub-one Extraordinary claims are made for it, but very few can be substantiated Certain species, no-tably camellias, orchids, and gardenias, are said to profit greatly by its use, probably because the plants

cannot themselves produce enough of the vitamin for proper growth All plants must have the vitamin, but most plants manufacture it and most soils have it in sufficient quantity if the humus content of a garden is adequately maintained, use of the vitamin is superfluous

If one tracks down to its source a tale of great success with Vitamin B-sub-one, it will be found very generally that the user has neglected to establish controls Unless untreated stock is planted side by side with treated stock, no valid conclusions can be drawn "Bigger and better" must always be qualified by reference to some controlled standard

All this work with chemicals has great significance. It is widening our knowledge of plant life and opening new vistas for scientific. exploration. Scientists and hybridizers will carry the work forward, but even the layman, if blessed with bright green thumbs, can make a contribution. There are a host of variables and unknowns left to be worked upon in the field and every successful field operation can be a contribution.

can be a contribution.

But don't forget Plant chemicals are not labor-saving devices, nor are they panaceas for horticultural ills if their role is not fully appreciated, there can be bitter disillusionment. If applied commercially applied commercially control to the property of the p

EFFICIENT TURBINES

Cheaper Electricity Should Come From New Installation

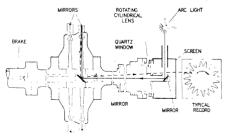
More efficient and safer steam turbines, meaning cheaper electricity for everyone, should come from the new, full-sized but completely experimental turbine installation displayed recently at the Schuylkill Generating Station of the Philadelphia Electric Company

The man behind this research, expected to furnish the bedrock of experience for tomorrow's sources of power, is F T Hague, engineer of the Westinghouse Electric and Manutacturing Company In his laboratory studies he had pushed turbine steam operating characteristics up to 1250 pounds pressure and temperatures of 900 de-

grees—hot enough to melt lead What he needed for a final test was a life-sized installation and a plant boiler capacity which could create the 125 tons of steam needed, each hour, to run such an installation The plant of the Philadelphia Electice Company provided such capacity

Moreover, this installation had to have some means of looking inside it and seeing how the turbine blades were vibrating under the extreme shock "To form a mental picture of this shock." Mr. Hague explains, "imagine a turbine blade moving 350 miles an hour abruptly intering a steam jet density moving 1200 miles an hour." Oscillations at the late of 126,000 times a minute occur in the blades, or 181,-440,000 per 24-hour day.

Just as trees sway in a gale, so, too do the turbine blades sway and



Optical system of the set-up for studying turbines in operation

vibrate under this super-hurricane of hot, "live" steam. If the vibrations are just right the blades enter into what engineers call resonance Eventually they break off as their sway becomes greater and greater

While the turbine blades are whilling some 60 revolutions a second around the turbine shaft, an automatic camera takes pictures through a tiny quartz window in the shaft at the rate of two a second

"With this new apparatus," Mr Hague explains, "a beam of light is carried through the shaft of the turbine and up into the blade itself, where mirrors reflect it out again, faithfully recording all vibrations. In this manner the harmonic movement of the blade can be recorded on film for any stated condition of operation.

"The light beam, supplied by an arc lamp, is deflected by a stationary mutor into the rotating shaft," he pointed out. "A slanded mirror inside the shaft throws the light beam through a hole in the totor disk and then through a smaller hole inside the blade, towards a small curved mirror on the end of a small curved mirror on the end of the blade. This curved mirror sends back the light by way of the slanted mirror in the shaft, to a screen.

"When the turbine rotates without vibration, the light point on the screen describes a circular path But when the blade vibrates, the curved mirror mounted on the end of the blade deflects the light beam away from this path and waves or notches appear on the circle. The wavy circle described by the light is recorded on film by a specially designed speed camera.

"By study of the resulting pictures the stresses on the blades are deduced directly from the magnitude of the waves by proper calibration. By shifting the mirrors, it is possible to measure side-toside as well as back-and-forth vibrations"—Science Service

STAR "JACKETS" Iron Shells May Yield New Information

Rom iron "jackets" which encase certain stars and give out peculiar kinds of ultra-violet light, incapable of reproduction in laboratories, physicists hope to learn more about the atomic structure of important earthly metals

Reporting in the Astrophysical Journal on researches he has made at the McDonald Observatory of



Three X-ray snapshots of bullets piercing blocks of wood. In center photo, note trail of lead: in right photo, bullet literally explodes wood

the Universities of Chicago and Texas, Dr Otto Struve, director of the Observatory and also of the University of Chicago's Yerkes Ob-

servatory, declares
"The importance of this work
consists in the fact that it provides
information about some of the most
common and useful substances, including chromium and titanium as
well as iron. Such information can
be found only in the stars."

The metallic jackets around these peratures far higher than the boiling point of iron Subjected to this intense heat, the atoms give off radiations which cannot be produced on earth, partly because there is not enough gaseous such high temperatures cannot be reached For this reason, physicists refer to these radiations as "forbidden" — Screece Service.

X-RAY SNAPSHOTS

Millionth of a Second With New Ultra-High Speed X-Ray

A hiple is fired in the research laboratory, and a builet tears through a block of wood placed between an odd looking glass tube and a flat aluminum box. A football player boots the pigskin from tis strange perch atop the same box. A golfer drives a ball from a makeshift paper tee on the box.

And in one millionth of a second of less than one twenty-thousandth of the time required to blink an eye —the glass tube produces and re-lesses a heavy surge of penetrating at Strays A few minutes later, on an X-ray film taken from the aluminum box and developed, Westinghouse research engineers can learn exactly what has hab-

pened during the millionth part of a second as the bullet plowed through the wood, the football player kicked the ball, or the golfer made his drive

Development of a new ultrahigh speed X-ray tube which enables engineers to make these fast X-ray "stills" was announced recently by Dr Charles M Slack, research physicist for the Westinghouse Lam Division

Westinghouse engineers believe development of the tube may presage a day when many desirable and hitherto impossible tasks may be accomplished Machine and motor builders, for example, will be able to study internal strains in rapidly moving parts Makers of sporting rifles, shotguns, and ammunition may determine any slight deflection of a bullet in its passage through a gun barrel, or observe the distribution of shot at various points in its flight from shotgun shell to muzzle. It is even held nossible that X-ray motion pictures may be made of such parts and objects, and many others

ATOMIC POWER

Released Spontaneously By Uranium

A TOMIC power is released from uranium spontaneously without atom-smashing bombardiment with neutrons, two Leningrad physicists report in the Physical Reneue, American Physical Society journal But the observations of the two Soviet scientists, Flerov and Petrjak, hold out no hope that there will be any practical utilization of this energy from the splitting of the uranium atom Only six fissions an hour were discovered —Science Service

Physics In Court

Computations by Which Police Can Work Out Driving Speeds from Skid Marks after Accidents

C. W. SHEPPARD

LTHOUGH the determination of the minimum speed of automobiles by the length of their skid marks has been known in courts of law for a good many years, it was not until quite recently that it was put on a systematic basis Since 1938 such cities as Evanston, Illinois, and Pasadena, Calfornia, have been keeping a systematic record of all skid marks left on the street after traffic accidents, and in the later city, due to the unceasing efforts of Police Physicist William W Harper, such evidence has become of increasing value in convicting law violators

Let us consider a typical case which recently came before a western court. A man and his wife were crossing the street. It was after dark, and in a section of the city which is not too well lighted A driver ran into them, inflicting severe injuries Measurements showed that the car skidded 65 feet after the driver applied the brakes. From simple calculations based on this evidence, his speed was shown to have been at least 40 miles per hour and, even in the absence of eye witnesses, he was convicted of exceeding the speed limit, on a basis of the skid alone

The computations involved in such a case are simple Those who can recall their elementary physics will know that the distance d, which a body of velocity v will travel under a deceleration, a, is given by the formula v'=2 ad This formula can be changed slightly to be more useful. If v is given in miles per hour, d in feet, and a is expressed as K (its percentage of the acceleration of gravity) the equation becomes vi=30 Kd To illustrate, let us suppose that a car has a braking power, K, of 70 percent This means, that, during a stop, it will have a force on it equal to 70 percent of its weight, which will slow it down at the rate of 22 4 feet per second every second This would be approximately the conditions encountered on dry pavement with ordinary tires

The value of K is known for a good many types of tires and road surfaces, but, unless it is impossible to do so, calculations are based upon test skids made with the car itself This method makes use of the fact. as seen from the formula, that the length of a skid increases as the square of the speed of the car. One must remember that, once the car begins to skid, the length of the skid becomes a matter of tire and road surface, independent of the effect of the brakes Any wheel which is not skidding will be so close to skidding as to be under substantially identical forces. The procedure is as follows Assuming that the car is not severely damaged after the accident, three trial skids are made at a speed of 20 miles per hour and under carefully controlled conditions From the known law of skid distance the minimum speed of the car before the accident may be found by simple arithmetic or by the use of

a chart devised by Mr Harper These charts, on especially prepared cross-section paper, permit speed in miles per hour to be arrived at quickly, and include allowances for varying co-officients of friction. They also serve as a permanent record of the several factors entering into the skid-speed test of the car.

Making skid tests requires that the car should not have been badly damaged Nevertheless, in the case of severe damage it is still frequently possible to estimate the speed of the car by the quite accurate information now available as to the friction of tires on various kinds of pavement Estimates of this type can be made by an experienced man and, though not quite as accurate as in the case of skid tests, they nevertheless often show conclusively that the car in question was exceeding the speed limit. In one recent case a car left skid marks 145 feet long and was demolished in a collision in which five people were killed When a K of 70 percent was assumed, a minimum speed of 55 miles per hour was given To this was added the conservative figure of ten miles per hour for the velocity absorbed in the collision damage, showing that the original speed was clearly greater than 65 miles per hour

As one might expect, courts have been slow to accept skid-mark evidence as conclusive Judges have sometimes consented to witness tests of the reliability of the method One such test was made in Pasadena. In Mr Harpre's absence a skid was made at 33 miles prour He hour He then was permitted to



Skid marks 60 feet long, left by a car at the scene of an accident. Marker boards are shown laid on the pavement at ten-foot intervals by the police



From a movie taken at Edison anniversary dinner, December 20, 1909. Mr. Edison left of center; Mr. Smith (see article below) second from left

measure the marks and calculate the minimum speed With little apparent difficulty he quickly determined the speed as being greater than 31 miles per hour

EDISON

One of His Co-Workers

Supplies An Anecdote

RECENT interest in the activities of that Grand Old Man of Inventors. Thomas A Edison, engendered by two motion pictures built around his life, gives added value to the photograph reproduced on this page. This picture, taken from a Mutoscope movie made in 1909, is claimed to be the first motion picture for which Mr Edison ever posed

For the reproduction of this illustration we are indebted to Mr Albert E. Smith, now of Hollywood, California, and formerly associated closely with Mr Edison. The occasion on which this movie was made was one of Mr. Edison's anniversary dinners, given on Monday evening, December 20, 1909

"Every year the moving picture producers of that day," writes Mr. Smith in a letter to the editor, "gave Mr. Edison an anniversary dinner at the Plaza Hotel On this particular occasion, before we went to the Plaza, we went to the old Vitagraph studios in East 14th Street and D. W Griffith took the picture

"I was very well acquainted

with 'the Old Man.' " continues Mr Smith "He was called this affectionately by all who knew him. U: ually at these dinners I would sit on Edison's right, not as a seat of honor. I think, but because my voice was high pitched and penetrating and the right was his better

"Of the many stories told me by Mr. Edison is one that I think will bear re-telling. It regards the sale of his first patented invention-the duplex telegraph system A group of men in New York had offered to buy the invention Mr Edison talked it over with his wife and they agreed that he should ask \$3000, if the buyers would not pay that amount he would come down to \$2000 but that was to be the lowest

"Mr Edison met the group in New York and after some small talk they asked him if he had arrived at a price Mr. Edison told me that he was so nervous that he stammered and could not get the figure out A dictatorial man among the group of would-be purchasers of the system broke in with, 'Now, it's no use asking us a big price, Mr Edison We have made up our minds what we will pay and we won't pay a cent more. In fact, I may as well tell you that \$40,000 is our limit ' Edison told me that he nearly fainted but rallied enough to assent

"The contract was drawn up." continues Mr Smith, "and Edison stipulated that he was to be paid in cash, in \$5 bills One of the men tried to talk him into taking a check but Edison did not trust banks and very plainly said so On the day of settlement he went to New York, signed the papers, and was paid the money With the bills stuffed in the pockets of his suit and overcoat, Mr Edison started home fearing that every man who looked at him knew that his pockets were full of bills

"When Mr Edison arrived home he was in such a funk that he sat up all night near the kitchen stove with a double-barrelled shotgun across his lap By morning he was nearly exhausted and decided to take the advice that had been given So he went back to New York and found the man who had previously suggested placing the money in a bank On Mr Edison's request. this gentleman took him to a bank and helped him to open an account

"Edison, in telling me of this experience," concludes Mr Smith. said that he then went home and within a month had spent all the money I was astonished and asked him how he had spent it. His reply was, 'On machinery I had never before had a machine shop. Then I had a good one ' "

INVENTORS AID

Physics Course Gives

Background Knowledge

INVENTORS and others who lack formal training in the fundamentals of physics, or who wish to review the subject, will be interested in a special course to be conducted this fall and early winter. Held at New York University, under the direction of Joseph H Kraus, the course will include rudimentary principles of physics and their practical applications in a wide variety of industrial fields

At each session of the course there will be an open forum for discussion of new inventions proposed developments, and so on

FLUXES

Aids to Welding

And Soldering

THE paradox of welding aluminum at a temperature below the melting point of the metal is achieved by the use of a welding flux developed by the Alwarth Chemical Corporation The new flux is used to coat the ordinary welding rod which contains approximately 5 percent silicon. The weld may then be made

without sweating the parent metal; hence, the area adjacent to the weld retains its full strength and ductility

Another flux for use on stainless steel, and made by the same company, is said to eliminate the unpleasant fumes ordinarily present in stainless steel soldering

Still another flux may be used on rusty iron, dirty brass or copper, or, in fact, any metal except aluminum By its use, retinning of rusted surfaces can be done with a minimum of labor

AVALANCHES BOMBED

Explosives Break Loose

Snow and Ice

WHILE much of Europe has felt the destructive power of bombs in recent months, at least one country has been using these deadly missiles for a beneficial use Switzerland is



Starting an avalanche

using them to shoot down avalanches under control

Each year in the Swiss Alps there are many victims of natural avalanches Mountain climbers are often eaught in them, and there is a sad record from the first World War indicating that on a single day in midcating that on a single day in one of the same of th

In the Alps, the blanket of snow is now regarded almost as a live thing that can become a deadly mence to humans. Hence the Swiss heave established a Snow Avalanche Research Station above Davos—the only one of its kind in the world. This station can foretell avalanches and issue necessary warnings Furthermore, if the svalanche location can be reached,

hand grenades are used to start it moving If big avalanches are involved, their descent is started by trench mortars

This work is being carried on constantly to safeguard the lives of skiers, of travelers over alpine roads, and of soldiers stationed in the mountains. The new method eliminates the great danger of the large spring avalanches which formerly, uncontrolled, often destroyed homes, bridges, highways, and roads.

SNAP RIVET

"Bachelor's Button" Fastener For Metals

A NEW spring locking button and fastener stud provides a rivel-type fastener for many uses. This button will substitute for the present speed units and screws and other types of nuts and screws and other types of nuts and screws of places it will always a finished provided to see the second of the second place in the second

The fastener stud has a head and a shank like the average rivet, but the shank is tapered toward the end and provided with a number of parallel ring grooves The spring locking button is made of this sheet steel with locking lugs extending inwardly from the opposite edges of the curved shell These locking lugs grip the rings on the shank of the stud

Because of its simplicity and the ease with which it may be installed, this new fastening unit may be used in the automotive, aircraft, and refrigeration fields. It can be made



Snap rivets and applicator tool

from any type of alloy, and the spring locking button can be made in any shape — circular, flat, diagonal — and in any size

HAM TELEVISION

New Transmitting Tube Now Available to Amateurs

NEXPENSIVE, a television camera every "tube which opens the field of electronic television to thousands of American radio amateurs, is a much simplified version of the more familiar "iconoscope" television camera tubes used in studio cameras. It is being placed on the market to sell at slightly less than 826.

With the new iconoscope, it is practicable for the first time for the anateur to build a complete electronic television transmitting and icceiving system at a total cost of approximately \$400 or less, depending on the equipment which he has at hand. Amaleurs who now have 2½-meter transmitters will find it relatively simple to adapt them for sending television signals alternately with sound broadcasts

The 120-line pictures transmitted by the amateurs' iconoscope,



Radio ham televises his call letters with new transmitter tube

while not of the same excellent quality as the 441-line television images being broadcast in New York, are remarkably clear and sharp, equivalent to newspaper half-tone reproduction. The new iconoscope transmits a television picture about 1½ inches square which may be enlarged at the receiver.

In research and development work on this new unit, RCA Laboratories collaborated with the American Radio Relay League, which has been seeking for several years to make it possible for the amateur radio enthusiasts to enter the television field. All the necessary equipment has been available for some time for amateurs, with the exception of the iconoscope Television receiving tubes, or kinescopes, have been available in sizes as small as three inches

It is believed that the opening of the electronic television field to amateurs will serve to widen existing popular interest in the new art and at the same time accelerate progress in television development The radio industry today points to a number of important steps pioneered by American amateurs, including the development of new circuits Radio amateurs were among the first to demonstrate the enormous possibilities of short waves, a region which at the time was not highly regarded for radio nurnoses

LIFEBOAT

Oarless, Motorless Boat Has Screw Propeller

READY for service in troublous times, the U S liner America is prepared for any emergency Fourteen of her lifeboats, for example, use a manually-operated system of push-pull levers instead of oars or



Push-pull levers in lifeboats



Levers operate a propeller

motor This method gives passengers something to do, eliminates confusion caused by inexperienced paramen

The propeller to which the levers are geared had to be designed within definite size and weight limitations. The Federal-Mogul Corporation solved the problem in an unusual manner They adapted their original "Equi-Poise" design. created for the propellers of Gar Wood's famous speedboat Miss America X, to the new lifeboats They then cast the wheels from Lynite, an alloy developed by the Aluminum Company of America, which cuts the propeller weight to one third normal, and has high resistance to salt water corrosion

Any number of crew or passengers from one to sixteen can operate the simple push-pull levers—and they don't have to work in unison—to move the boat. It has a maximum speed of six miles per hour.

The idea behind these novel lifeboats is that they will provide sufficient speed quickly to carry a large number of people away from immediate danger, and thereafter they can be towed by the America's power-driven lifeboats

WOOD SEASONING

Urea Prevents Drying Losses

CRYSTAL urea is now being used as a chemical seasoning agent to prevent checking, splitting, and such losses as occur in drying lumber in the air or in the kiln Freshout lumber dries first at the surface, but when treated with a solution of urea, the outer surface remains moist and drying proceeds from within, thus eliminating the stresses that cause troubles.

This treatment is easy to apply, permits faster and more severe kiln schedules, thus increasing the plant output. Urea, non-toxic, stable and harmless to the skin, is

not corrosive to metals used with wood or to tools or knives employed in dressing lumber. Urea-treated wood is also less flammable and less susceptible to attack by fungi and rot than untreated wood.

Mill-scale treatments on Douglas fir and hemlock in the Northwest and on red cypress in the South are now being made Tests are in progress on other woods —The duPont Magazine

STREET CARS

Modernized for

Modern Service

ALTHOUGH people generally have the idea that street cars are on the way out, these vehicles continue to be improved so that they render in-



Controls on a modern street car

dispensable service in certain localtitles. San Francisco, for example, has just put into service a number
of streamlined, street cars which
operate and stop without a jar or
joli, ride smoothly even at rail intersections, and, in fact, give service that is modern in all respects
Our photograph shows the manner
in which the motorman's cockput
has been modernized, following in
general the design of automobile
dashboards.

IAP BEETLES

Yellow Traps Found Most Effective

The bright yellow color of the Japanese beetle traps set in 1940 by the Bureau of Entomology and Plant Quarantine of the U S Department of Agriculture is the result of research developments in tests last season Most bedie traps had been green, or green and white The "scouting" traps widely distributed by the Federal entomologists were uniform, but traps on the open market were available in many shades of green, and the

beetle research organization decided to investigate differences in attractiveness, to the beetles, of the various shades of green, as well as a of other colors. This investigation showed that traps painted yellow caught approximately 50 percent more beetles than the standard green and white traps. Yellow pigment added to any other color of paint increased the numbers of beetles cantiled.

PLANT TAGS

Metal Labels Provide Permanent Identification

A special alloy of metal flexible and resistant to acids and ground chemicals, has solved one of the most annoying problems of gardeners Professor Aden J King, who is a gardener as well as a college professor of chemistry, has used this metal to make a plant label. Since it is similar to a very heavy foil, a soft pencil is all that is necessary to print the name of plants or shrubs on this new Perm-A-Tag The printing makes a permanent impression in the metal The user may, if he so desires, mount the strips in his typewriter and type the names thereon After that a tongue and slot arrangement makes it easy to loop the label around a plant or shrub and clamp it firmly without the use of any

EYE PROTECTION

Variable Sun Glasses Give

Inteconventional sum glasses with tutted lenses offer only one degree of brightness control for the wearer Polarod sum glasses soid in previous years, while they provided better protection for the eyes against the glare of sun, still offered one degree of brightness control However, the Polaroid Corporation has now developed a Polaroid



Set for maximum transmission



Set for minimum transmission

Variable Day Glass which permits the wearer to control the brightness of the view

Instead of only one lens before each eye, the new Polaroid Variable Day Glass has two lenses. The front lens before each eve is stationary in the frame while the two rear lenses may be rotated by a convenient button on the bridge of the frame Simple movement of this button with the finger rotates the rear lenses so that more or less light may pass through, according to the angles between the polarizing material in the front and rear lenses Thus the wearer may cut down light transmission on a very brilliant day or allow more light to pass through on a duller day Adjustment of the lenses may always be such as to provide the greatest comfort and efficient vision for the user, regardless of his particular tolerance for excessive brightness

POST DRIVING

Small Explosive Charge Drives Piling or Posts

OFTEN It is essential to put a pile or post in water or wet ground where a pile driver is not available, or when so few piles are to be driven as not to warrant bringing in a heavy piece of equipment.

A method has been worked out whereby the force of dynamite can be used to transmit a blow which is somewhat similar to the dropping of a pile driver hammer The pile is stood upright in the location desired, and braced in placeusually with rope. The head of the the procedure is to put a heavy plate of steel on top of the pile To give the best results, the plate should be one inch to 11/2 inches thick One stick of dynamite is placed on top of the plate, and covered with mud after the stick has been properly primed with a blasting cap and fuse or an electric blasting cap When the charge is exploded, the force is transmitted to the plate which in turn transmits it to the pile. The pile is driven into the ground sometimes as much as 14 inches if the ground is soft. The procedure is then repeated until one inch penetration per explosion is obtained—Agricultural News Letter (du Pont).

FLASHLIGHT

Rod-like Gadget Extends Any Flashlight

For use in inaccessible places, a flashlight bulb extension has been developed Made in lengths of from six to 36 inches, the extension's



To get light where needed

plug is screwed into any flashlight; a bulb is in the socket on the other end Being bendable, the extension can be inserted into intricate mechanisms, or into bores on a lathe It aids vision down between walls, back behind fittings, inside of models, down among gears—in fact, any place where there is at least one-half inch clearance for the bulb end.

Known as the Sierra Flashlight Bulb Extension, the device is made of special wire encased in aluminum alloy tubing

CHEMICAL GARDEN POTS

Home Plants May Now Be

Grown in Chemicals

dome experimenters in chemical gardening who have been handicapped by lack of suitable and attractive containers may now thank Ernest W Brundin for making chemical gardening pots and gardens available. This large commer-

MISCELLANY-

cial grower of tomatoes in nutrient solution and founder of Chemical Gardens, Inc., has designed glazed, two-compartment, pottery containers in a variety of shapes and colors. Either seeds, seedlings, or mature plants may be grown in these

Mr Brundin's containers are made in two parts, the upper one



For feeding plants chemically

fitting into the lower one and maka complete unit of attractive design. The lower one holds the chemical solution in water The upper is filled with clean, sharp sand A terra cotta wick extends through a hole in the bottom of the upper section down into the water Capillary attraction supplies plenty of water and food to the sand bed

Two small bottles of plant food concentrates are supplied with the chemical gardens, and last for many months A quantity of each solution is measured into a given quantity of water about once every 15 days, and the mixture poured into the bottom section. The chemical balance of the prepared higuids is such that changes made by the plant in the silica bed are constantly corrected automatically by the supply coming up through the wick

INSECT-REPELLENTS

There is no Plant Which Repels all Insects

INT idea that certain plants in the garden will drive away measuriose and all other insect pests is attractive, but unfortunately, says F C Bishopp of the United States Department of Agriculture, it does not seem to work out in practice not seem to work out in practice No such plant is known. If any plant were a good repellent, it would probably be because it con-

GOOD SERVICE

is Good Business

by Westinghouse



- Probably it never occurred to you, but the life of a Westinghouse Service Engineer is a very exciting career. This morning he may be doing a simple repair job, and this afternoon he may be aboard a plane speeding to the rescue of a power company miles away whose electrical equipment has been paralyzed by some disaster.
- For instance, we recall the hortcane that swept the Atlantic seaboard in 1938. A record tide played havoc with the generation equipment of one of New York City's great power plants. At midnight our Service Department received the emergency call. By morning, the entire New York field force, reinforced by service men from our Newark, Putsburgh, Buffalo, Utica and Philadelphia Service Shops were on the job.
- They found machinery flooded with salt water and drenched in a sludge of oil. 35 large pumps and auxiliary motors and their electrical controls were affected. Yet by the middle of the fourth day, one of the generating units was back in service. A crew of 135 men working in three eight hour shifts soon had the entire station back in normal operation.

- Only a year before our service men braved even fire to help a Cincinoart customer continue operations. Because our men stayed on the job in a building choked with smoke and intense heat from an adjoining fire, the company was able to maintain its regular production schedule.
- Ingenuity is also a prime requisite of these service men. For instance, our New England men were given the problem of drying and smoothing out water soaked currency, bonds and other valuable papers soaked by flood. They did it promptly and efficiently simply by using Westinghouse household ironers to press the paper straight and dry.
- These are only a few examples of the score of unusual tasks a Service Department must perform. Actually, this dupartment, in our case, is an industry within itself. We must manufacture millions of dollars worth of service equipment each year. This includes special equipment as well as renewal parts for apparatus which is no longer in regular production.
- To meet the unending demands for electrical service we maintain thirty-six servee plants strategically located throughout the country. More than 3,000 men are normally employed. No piece of electrical apparatus in America is more than a few hours by rail, boat or plane from these plants, equipment and me.
- Naturally, we are proud of the record of this department. And we, as many others, consider it one of the most important arms of our business. Good Service is always Good Business.

CNNO ----

Where Science Ends Hospitality Begins



The Waldorf, for example, is a magnificent scientific achievement not only dependent on science when it was built, but continuously dependent on many sciences for the efficiency of its operation.

But every man of scientific turn of mind knowwhat we mean when we say that hospitality, in his own home no less than in the Waldorf, is something warm. In mg and human that survives scientific detachment

And it is that ability to preserve the human touch, in spite of all our clockwork schedules and efficiency, that gives the Waldorf its unique reputation for maintaining close, cordial and communicable contacts with its patrons

Besides, this year, when you come to New York, you'll get so much science at THE FAIR, that it'll be a genume relief each day to return to the hospitality of The Waldorf-Astoria!

THE

WALDORF-ASTORIA

PARK AVENUE 491H TO 50TH NEW YORK

THE MOST EXTENSIVELY AIR-CONDITIONED HOTEL IN THE WORLD

= 0000 =

-MISCELLANY-

tained some chemical substance offensive to all insects Scientists have sought such a chemical but never have found one.

There are chemicals effective against certain insects, but differences in sense of smell among insects appear to be as great as among the higher animals, says Bishopp, who studies insects that affect man and animals Don't put too much faith in chemical repellents or any other single type of protection against all insect pests, he advises

DUPLICATORS

New Method for Making Employs Photochemical Stencils

A NEW method of making duplicate copies of line drawings in quantity has recently been developed by A B Dick Company, makers of the Mimeograph duplicator The new Mimeograph photochemical printer



Drawing duplicator

makes possible quick, accurate transference of any opaque drawing to a stencil sheet for black-andwhite reproduction

The chief element of the printer is a new cool, brilliant light source, unvarying in intensity, with remarkably low consumption of electricity and dependably constant results. Around the evenly distributed light-tubing is a heavy, unbreakable transparent cylinder free of blemishes that might affect the exposure of the stencil sheet

To make the photochemical stencil, it is first made light-sensitive with sensitizing solution. Next, the original racing and the stencil sheet are exposed to light in the printer By this exposure the image on the tracing is transferred to the sensitized stencil sheet in a single step. The stencil is then developed on the developing plate and placed on the Mimeograph duplicator for black-and-white reproduction of dozens or hundreds of copies, as desired.

The time of the procedure, from finished drawing to finished copies, is generally less than 25 minutes

MISCELLANY-

Price of materials for producing the stencil-including the stencil sheet-is less than 25 cents

Any size drawing up to 71/4 by 14 inches, on paper not larger than 81/2 by 16 inches, may be used as an original The only requirement is that the image on the original be thoroughly opaque and the exact size desired in the finished copies India ink tracings on translucent cloth or paper are recommended for best results Typewritten matter cannot be reproduced on the photochemical stencil

The photochemical printer is portable and may be used in mechanical aits and music departments of schools, engineer's offices, and factories A few suggested applications are quantity duplication of tracings for engineering, production, and sales engineering departments, erection and installation diagrams, graphic instructions of all kinds, technical illustrations for parts and instructional catalogs

The printer requires alternating current, 60-cycle, 110 volts

PAINT DRYER

Infra-Red Lamps Given New Job

More and more are infra-red rays being utilized for finish-drying purposes These heat rays in suitable reflectors have been utilized for several years to dry very rapidly the lacquers on, for example, automobile bodies Now small infra-ted lamps have been given the job of drying many things around the home. At the flick of a switch the housewife may soon tuin on lamps to dry the family washing quickly and economically, cook



Infra-red dries paint quickly



CAN MAN REACH REVOND THE VEIL?

On the Edge of Eternity

S o CLOSE and vet so far from the source of all is man Are we allowed but a fleeting glance at the universe just a conscious interim on the stage of life a brief look at the setting the stage, and our fellow players, Must each minute be lived regardless of what it affords or can life be an intelligent choice a time well used to gam a desired end. Not alone in the vapors of test tubes, or the misty voids of the telescope. will man find the answer to the riddle of life and that course of living which brings mastery of self and happiness but in the depths of his own being

The surges of self which the emotions well up within you, the flashes of intuition which break through your consciousness in spite of superfluous interests are the signs which point a way to contact with infinity -the primary cause of all Certamly you are not - nor are men generally averse to brilliance

of mind to creative ideas which make for accomplishment, and have their worldly counterpart in demands for your personal services and success in any en-

Therefore, let the Rosserucians (not a religious organization), and age-old, world-wide frater mty, reveal to you the simple methods used by the sages and master thinkers of vorc for shaping the elements of your environment into a world of personal achievement. This knowledge goes beyond more faith or belief. It is the ageless science of life, which has accounted for most of the world's greatest thinkers and doors

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food, or heat a room or an entire house in cold weather.

Our accompanying illustration. used through the courtesy of Westinghouse, shows a particularly important use of such lamps for drying interior paints. In such use, household annoyance due to 1epainting is greatly reduced, or an apartment is made ready more quickly for incoming tenants Furthermore, the paint is dried so quickly that there is little chance for dust settling on the surface

NAVIGATION TABLES

New Method Decreases

Computation, Simplifies Study

A SIMPLIFIED method of determining the position of a ship or an airplane, eliminating nearly all the involved mathematical computation of older procedures, is now available for ocean commerce and modern, high speed, air transporta-

This new method is based on the use of navigation tables which are being computed and assembled by the Work Projects Adminstration in co-operation with the Hydrographic Office of the United States Navy WPA workers, under the supervision of the Hydrographic office, have assembled the tables in volumes covering 10 degrees of latitude, usable in both the southern and northern hemispheres Four volumes of this work are available to navigators, while a fifth will be available this year

Under ordinary conditions, a training period of at least eight months is necessary to develop facility in navigation With the new tables, it is estimated that the training period can be reduced to about six weeks. By using this new aid-called "H O 214-Tables of

Computed Altitude and Azımuth" -a navigator either at sea or in the air can find immediately the altitude angle and azimuth, or bearing, which correspond to his assumed latitude and longitude without having to compute it

All U. S Government services, including the U S Navy, Coast Guard. Army Air Corps, and the Coast and Geodetic Survey, are now using these tables in their navigation and scientific work while an increasing number of private seamen, yachtsmen, and aviators of all nations are finding the easier method valuable

DRAFTING CAMERA

Huge Machine Copies Large Drawings Quickly

An important new process by which engineering drawings are directly reproduced, photographically, on nearly any kind of surface (metal, wood, cloth, and paper, to mention a few) has been an-nounced by The Glenn L Martin Company This new process is credited with much responsibility for the factory's mass-production methods in building airplanes, and is expected to have wide application in many other industries

An heroic-scale camera snaps pictures of large drawings, the negatives are developed, and the images projected back to large sheets of aluminum alloy sensitized with a special emulsion When such a sheet (maximum standard size used is 10 by 5 feet, but it could be larger) is placed in huge developing tanks, the drawing appears in all its preciseness on the surface in exact scale-or in fractional or multiple scales, if so desired

Thus there can be produced in



Laying out sirplane parts drawings, later to be photographed



Looking through the giant camera with which photo prints are made on metal, wood, and so on

a matter of minutes any number of drawings which might have required days in redrafting company saved more than \$80,000 last year in drafting alone Engineering work is speeded tremendously Tool designing and tool making gets under way more rapidly and more accurately Production preparation starts quicker and changes are made more rapidly And because there are plenty of the exact-scale drawings available, the whole effort of the several vital departments is co-ordinated, all of which adds up to incomputable savings

The versatile process has many other uses in the plant Where an experimental airplane is to be built, the master drawings, absolutely accurate in every detail, can be photographed directly onto the metal of which the ship is to be constructed and the parts cut directly from the material itself. If a wind-tunnel or water basin model of a projected airplane is desired. it is only necessary to call on the camera to scale down the lines instantly from full size to an eighth, or tenth, or any other fraction of the full size An easy calibration of the camera turns the trick, saving perhaps weeks of redrawing to

SOIL MOISTURE Simple Test for Water in Farm Soil

A SLOCK of plaster of Paris the size of a match box, some wire, and a small electrical apparatus so simple to operate that no training is required, are all a farmer now needs to determine the amount of water in his soil. The new method of measuring moisture in the

ground was developed by the soils section of Michigan State College A continuous measurement of soil moisture changes can be made by the process without disturbing either the soil or the crop

In this novel approach to agroomnic and irrigation problems, a block of plaster with attached wires is buried in the ground and allowed to absorb water until an equilibrium between it and the soil is established By using an ordinary piece of electrical equipment known as a Wheatstone bridge, a measurement is then taken of the amount of resistance to electricity offered by the block

Since water contained in soil readily conducts electricity, the greater the amount of moisture present the wetter the plaster and the less the resistance. If the ground is dry, the block offers greater resistance. Many absorption blocks may be distributed over the growing area at various depths to provide a complete picture of water fluctuations and movements within the soil and to furnish numerous control points.

The lead wires can be buried below tillage depth. When a measurement is desired, the block is connected to the bridge and the resistance can be determined in from 20 to 30 seconds. The electrical apparatus, being portable, can be used with any number of absorption blocks.

When the resistance of the absorption block becomes constant at about 400 to 600 chms, the soil in which it is imbedded is holding about the maximum amount of moisture desirable for the growth of most plants. On the other extreme, as the resistance of the block passes to 60,000 chms, soil moisture is approaching a minimum level with regard to plant requirements. Few plants will thrive in this dry soil and most plants will if more moisture is lost.

RIVETS

Explosive Forms Heads Without Backing Up

In constructing such machines as tanks and airplanes it is often necessary to rivet the shell at points where it is impossible for someone to back up the rivet in order to form a head. As long ago as 1937 the German Heinkel concern partially solved this problem by production of a hollow rivet containing an explosive. This rivet was to be inserted in the rivet hole



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-MISCELLANY-

from the outside and, when heated, it exploded to form a shank inside to hold the plates together. However, the explosive corroded the opposite surface of the plate and the cost was high. Furthermore, Heinkel bombers shot down in England show that such explosive rivets are far from uniform and are used only in unstressed parts.

The DuPont company has improved upon the explosive rivets by developing an explosive powder which gives complete uniformity of explosive force and, therefore, uniformity of the rivet heads that are formed by that force This powder is said to be non-corrosive and the cost works out at about three cents per rivet. Riveting is done with a simple electric or benzine heating gun, the time for each rivet being about 1½ seconds.

Besides facilitating construction, these rivets may also be used effectively in iepair work. A hole made by a bullet or a shell fragment might be trimmed out of a plane wing, a patch fitted in place, and fastened tightly by means of these rivets.

"MAGIC" LANTERN

Visual Aid Throws Stereoscopic Pictures

FOR the first time in the history of the manufacture of visual aids for selling and teaching, an automatic projector for showing glass slides in three dimensions is now being made. It is the Real Life Projector

projector for showing glass slides in three dimensions is now being made. It is the Real Life Projector of the Three Dimension Corporation. Slide pictures projected from this machine onto a screen and viewed through Polaroid spectacles give an appearance of true depth.

The machine is entirely automatic in its operation, feeding automatically all the slides in a tray holding 35. When that is



"Magic" lantern up-to-date

empty, it may be instantly replaced with another fully loaded

Business executives interested in showing the true contours of products, the true color of finishes, or the true texture of fabrics and surfaces, might use this device to advantage. In lectures of many kinds and in many fields of education it would prove a welcome aid to the speaker or teacher.

PLUG-IN X-RAY

Portable Machine Has

High Capacity

PORTABLE and shock-proof yet having the 80,000-volt capacity of much larger standard machines, a new X-ray machine introduced by



Portable X-ray

Profession Equipment Company promises to perform jobs hitherto impossible because of the bulk of older equipment. It was designed and assembled with the co-operation of C. E. Waltman and Associates.

The new machine is demountable and easily portable in two small carrying cases, the total weight being only 64 pounds. It plugs into a regular electrical outlet

BATTERY TESTER

Pocket-size for Servicemen

A POCKET-SIZE battery tester to meet the need for a compact, nexpensive unit for correct testing of dry batternes under load, has just been announced Made by Weston Electrical Instrument Corporation, the new unit will be of particular interest to radio servicemen whose tube checkers do not contain provision for this important new test

batteries should be tested under heat

The nocket-size unit has been designed to fulfil the fundamental requirements for correct battery testing, that is, when the battery shows "good" on the instrument



To test dry cells under load

scale, it will be capable of delivering sufficient potential when under full load

In order to facilitate new battery sales and replacements, the scale consists simply of a "Replace ---Good" indication, uncomplicated by voltage indications, which might be confusing to the layman Pin jacks are provided for the different battery voltages encountered 15. 45, 6, 75, 45, and 90 volts

TRACING PAPER

Better Blue-Prints

From Pencil Sketches

BRAFTSMEN often have occasion to make relatively complete drawings on tracing paper in pencil When blue-prints are made from these, however, the lines are usually very weak and never completely satisfactory The Frederick Post Company has developed a new paper called PTM which not only gives greater depth and blackness to the pencil line but also is more transparent than ordinary tracing paper The surface of this sheet is dull and has a sharp but very fine "tooth"

WAR GASOLINE

It is figured that one day's operation of a fleet of bombing and pursuit planes necessitates the consumption of an amount of motor fuel sufficient to operate 3000 American passenger cars for a full year!

Data show that 2400 bombers consume about 288,000 gallons per hour, 1600 pursuit planes consume 160,000 gallons per hour Total daily consumption, on the basis of five hours in the air, exceeds two and one-quarter million gallons of fuel

Consumption by tanks, trucks, armored cars, motorcycles, and other motorized equipment is believed to be even greater -American Petroleum Institute

RUST PROOF NAIL

Unique Design For Boots Out-Holds Screw

A NEW rust-proof nail of odd and unique design, developed for the boat-building industry, has revealed in a series of tests an unusual combination of properties which indicate its value for a wide range of industries where corrosion is encountered. In a special demonstration for naval architects it outhold a screw

The nail is made of Monel and its holding power is derived from a series of sharp annular rings rolled-on in manufacturing operations These rings are sharp and set at such an angle that in driving



Annular rings, rolled-on, give nails unusual holding qualities

they won't disrupt the fibers of the wood The nail can be driven quickly without drilling a pilot hole-even into oak-and it requires no clinching

Another feature of this new nail is an exceptionally heavy head, in the case of a two-inch nail, the head is 5/16 of an inch in diameter and 1/16 of an inch thick. The heads are two gages heavier than in wire nails of corresponding lengths

An outstanding property of the nail is that it is permanently rust proof and highly resistant to salt water and other agents of corrosion, including tannic acid. Thus it will not produce a stain to discolor the wood into which it is driven



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Careers in Photography

monates frequently lead enthusiats to full-time trades and professions. This is particularly true of photography, especially since it may often be used in combination with some other used in combination with some other activity either in an auxiliary capacity plays or can be made to play an important part were discussed at a recent Conference on Photography held in New York City under the auspices of the Institute of Women's Professional Relationship of the Conference of the



By Mertin Langan from the Pourth International Leion Exhibit Professional, Portraiture

a job, most of the speakers described the requirements and opportunities in their several fields as they applied

to all beginners without regard to sex More than 20 major photographic fields were discussed by authorities in each field, but the general oninion seemed to be that the photographer who desires to make a success of his chosen profession must have a good technical training, good general background, and a good knowledge of the particular field in which he expects to work. In addition to mastering the technical problems of photography in his field, said Roy E Stryker, Chief, Historical Section, Bureau of Information, Farm Security Administra-tion, the photographer "must recognize that photography is a product of the intellect rather than a product of mechanical skill " Mr Stryker, covering the subject of "Photography Social Science Research," said. order for the Farm Security Administration photographers to do their camera reporting they must be something of sociologists, economists, historians That they be expert camera craftsmen is taken for granted. That they have a good general background coupled with the faculty for acquiring a working knowledge of a variety of subjects is essential

Nor did the speakers fail to warn prospects that photography is not easy work, particularly in the news-picture field. "Camera work has its share of held heartaches and disappointments." said William Eckenberg, of New York One must be Times Rotogravure. ready at any and all times to work 24 hours and more at a stretch and often go without food News photographers must be hardy enough to withstand all kinds of weather and abuse. Many of them have sacrificed home life and even life itself, in the pursuit of news pictures

To beginners looking for an opening, Miss Jackie Martin, ARPS, Photographer and Art Director of the Washington Times-Herald, speaking on "News Photography and Photo-Editing," gave the following sound reduces.

advice
"I should think the best chance for
a job would be a small finisher or
portrait studio, free lancing for papers
or magazines (this very small pickmags, however), join camera clubs,
submit prints for exhibits, get jobs in
photo stores which are hopping up
like mushrooms. Develop ability to
write and make pictures, for the coming of tabloid type or caption type of
story makes that an ideal combination.
I think the big thing is to learn about
photography, be trained, and the

opportunity to work at it will follow "
Although the conference was slated
to discuss photography as a means of
crereation as well as a profession and
an adjunct, only one speaker discussed
Frank Lium, president of The Photographic Society of America and The
Metropolitan Camera Club Council,
who described photography as "an
indispensable adjunct to a wider enjoyment of life, even if one does not
appret to technical or artistic excel-

ence "
The value of a good working knowl-



rtesy Devin Colorgraph Corp

Adjunct: Illustration

edge and scientific background in the particular field chosen by the photographer was patent in the very subjects discussed by the various speakers These included papers on photography in biology and medicine, by Earle B. Perkins, director, Rutgers University, Department of Biophotography, chemistry, by Wanda K Farr, director. Cellulose Department of the Chemical Foundation, Boyce Thompson Institute for Plant Research, Inc. "Photography in Industrial Research," by John Mills, director of publications,

Bell Telephone Laboratories, "Cinemanalysis A Psychological Research Technique," by Dr Arnold Gesell, director of The Clinic of Child Development at Yale University, "Guidance Through Visual Expression," by Evelyn S Brown, of Harmon Foundation, New York City, "Cinematogra-phy in Graduate Studies," by Robert Chambers, of New York University

Other subjects covered included "Aerial Photography as a Profession, by William H. Meyer, Jr., general manager, Fairchild Aerial Surveys, "Photography in Advertising," by Walter B Geoghagen, president of the Art Directors Club. "Civic Docuthe Art Directors Club, "Civic Docu-mentary History," by Berenice Ab-bott, "Theatrical Photography," by Florence Vandamm, FRPS, a talk on photography as a profession by Wynn Richards, "Women's Oppor-



Adjunct: Social

tunities in Public Service Film and Photo Agencies," by Arch A Mersey, assistant director, United States Film Service; "Photography in the Li-brary," by Ralph H Carruthers, in charge of Photographic Service at New York Public Library, talks on various aspects of museum photography by G Lauder Greenway, assistant secretary, The Metropolitan Mu-seum of Art, Beaumont Newhall, The Museum of Modern Art, New York, and Iris Barry, curator, The Museum of Modern Art Film Library; "The Teaching of Photography," by Frank-lin J. Keller, principal, Metropolitan Vocational High School; "Photography in Education, Educational Photography and Teaching Photography,"



Recreation: Hobby

by Adrian Ter Louw, Eastman Kodak Company Talks by Edward Steichen and Fairfield Osborn were discussed in a previous issue

Moral: Use a Stop Bath

F you allow light to fall on film before it has been fixed, the inevitable consequence is a completely ruined film At least, that's the way we have all been taught. However, all is not necessarily lost in such circumstances as witness the experience of a friend who did that very thing and yet saved the day After developing the film he poured the developer solution out of the tank and poured in the stop bath Then he was interrupted by visitors and upon returning to the tank forgot that the film was in the stop bath, not the fixer, and opened the tank He removed the films (he was developing filmpack) from the tank and found the tell-tale milkiness that indicated the films had not been fixed. He washed the films anyway and let them dry About a week later(1), he attempted to mend matters by immersing the negatives in the fixer even at that late date, since there was nothing to lose and everything to gain The films result surprised him "cleared" and became printable negatives All thanks, of course, is due to the use of a fresh stop bath, which arrested development and turned failure into success

Fine Grain, Germain

DISIGNED by Morris Germain, veloper for students and serious minded amateur photographers whose efforts in compounding photo-chemical solutions need encouragement," his fine-grain formula, given below, has met with popular favor with amateur and professional photographers alike.

Water (125° F or 52° C) 32 oz or 1000 cc Metol 1/4 oz or 7 pm Sodium Sulfite . 21/2 oz or 70 gm Paraphenylenediamine (base) 1/4 oz or 7 gm Glycin 7 gm. 1/4 oz or

Mr Germain, who is Technical Advisor for Penn Camera Exchange, New York City, gives the following instruc-tions: "The use of distilled water is preferred Dissolve the chemicals in the order listed. Use without dilution For replenisher, use the same formula Thirty-two ounces of this formula will



Bass says:

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[For Complete Contest Rules, See Page 94, August 1940 Scientific American]

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'N this year's contest, prints may be entered in any or IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPE-CIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners These special awards will be given in addition to the regular prizes that the pictures win.

DIVISIONS IN WHICH PRINTS MAY BE ENTERED Division 1 Human interest, including camera studies of people

animals, and so on Portraits will be grouped in this division Division 2. Landscapes, including all scenic views, seascapes, and so on

Division 3 Action, including all types of photographs in which action is the predominating feature.

THE PRIZES

Watches.

1st. Three \$125 LONGINES, Corona- 4th. Three FEDERAL No. 345 tion Model, Solid Gold, Men's Wrist Photo Enlargers (List Price \$42.50).

sentation Model, Solid Gold, Men's \$19,75). Wrist Watches.

5th. Three PIERCE CHRONOGRAPH 2nd. Three \$85 LONGINES. Pre- Men's Wrist Watches (List Price

3rd. Three FEDERAL No. 246 Guns complete with case (List Photo Enlargers (List Price \$49.50). price \$15).

6th. Three BERMAN-MEYERS Flash

7th. Three FINK-ROSELIEVE Vaporators (List price \$12.50)

HONORABLE MENTION

3rd. Three Raygram Wood-Chrome Tripods.

1st Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

oping tanks.

4th Three Fink-Roselieve Audible Timers. 2nd Three Mimosa Perkino devel- 5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price \$24.) 2nd. One No. 650 Weston Exposure Meter (List price \$19.95.) 3rd. One No. 850 Weston Exposure Meter (List price \$15.50.)

THE JUDGES: T J Maloney, editor of U S Camera

McClelland Barclay, artist Ivan Dmitri, artist and photographer Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street

New York, N. Y.

CAMERA ANGLES-

develop 12 to 18 five-foot rolls of 35 mm film or its equivalent in area. The developer should be filtered after compounding and again thereafter, each time before use. This will insure against 'pin holes' from foreign matter or normal precipitates that may be present in the developer solution

Among the advantages listed for this developer are good keeping qualities, maintenance of energy over a longer period of time with consistent use, no extra exposure compensation required Developing time is 8 to 10 minutes for film having Weston rating under 50, 12 to 15 minutes for Weston rating shove 50

One Subject. Many Pictures

HE most obvious truths of photog-The most obvious trues of property raphy have to be repeated now and then because people seem to forget them so easily As a result, they over-look pictures that are right before their eyes, but take some study to see One of these truths is that a single subject may offer more than one shot Mrs Alterman, of Mount Vernon, New York may have been thinking along these lines, or perhaps it was simply because she liked the particular spot, when she planned and shot a series of nictures around a certain wood fence

Two of these pictures are reproduced here Each one is distinctly different from the other. It was just a matter of clanging the viewpoint Personally, we like the close-up shot better than the "long" shot of the tence But that is just a matter of opinion In any event, a series would necessarily call for the inclusion of whole subject in at least one of the pictures, which may then be supplemented by close-up views of details

In addition to viewnoint there is also the opportunity of photographing the subject in different seasons Mrs Alterman has done this as well, photographing the scene in the fall and again in the winter with snow instead



From one viewpoint . . .



. . . and from another

of fallen leaves to identify the season. This kind of photography is a sort of exercise which every worker should now and then indulge in every if he never shows the results. It is the kind of experimentation that will stand him in good stead when the "real picture" comes along

Solution Bottles

PRESENTAY we came across some empty gallon size brown bottles used by manufacturing chemists for packaging their chemicals, that struke us as being admirably suited for storing or large Bakeliet threaded (ap is about an inch deep, has a wax conting at the bottom of the cap to preserve the contents of the bottle, and the neck of the bottle is designed with an in-denture at the edge to hold the bottle on the rim of the graduate or bottle on the rim of the graduate or bottle

If you have a chemist friend by all means get him to let you have one or more of these bottles as he empties them If he can spare them, of course They seem ideal for mixing large quantities of solution for distribution among several smaller bottles, or even for storing solutions for describing one of these and used the bottle for mixed a gallon of paper developer in one of these and used the bottle for the form the bottle sociationally over the course of several months, gradually depleting it, there seemed no evidence of serious oxidation

Daumier and Candid Photography

COMMENTING on a group of Daumer's sketches as paralleled in the work of some of today's candid photographers, Ralph Stemer, writing in a recent issue of PM, remarked on the similarity in viewpoint of the artist and the photographer

"The candid camera photographer today can catch in a fraction of a second a gesture, an expression or a pose that the painter may labor over for hours," writes Mr. Steiner. "But just because the painter works slowly, he is more likely to choose significant gestures—ones that express the relationship of people to each other, or that express their feelings, thoughts, characters

"This should be the job of the candidate in the property of the total that he can take the picture at a 1/1000th of a second, and catch an accidental gesture, like the politician de-waxing his car.

"The good candid photographer should play the same part as a recorder of human thoughts and feelings as a painter such as Daumier played for his time"

Kalart Contest

most than \$500 in merchandise prizes III soffered by The Kalart Company, Inc. 915 Broadway, New York, N. Y. Or pretures taken with a Kalart Speed Flash, both outdoors by the Synchrosulight method, and indoors This year's contest, which is wider in scope than in former years, offers a total of 35 grand prizes including an Anniversary Speed Graphic as the First Grand Prize, a Simmon Super Omega B Enlarger, a Solar Enlarger, a Federal Enlarger, a Kalart Lens-Coupled Range Finder, and other prize, and other prize.

Any number of prints may be submitted, either mounted or unmounted. In addition to the 35 Grand Prizes, the Kalart company each month will award a case of Wabash flash bulbs and a new Kalart Concentrating Reflector for the best photograph reerved during each of the following months: August, September, October, to which the subtion of the submonthly prizes Speed Flash photos winning monthly prizes will also be eligible for Grand Prizes

The contest closes at midnight, December 1, 1940 Entry blanks are available from photographic dealers or by writing to the company

100 Years of Progress

A HUNDRED years ago and today in photography is strikingly illustrated in this picture, which needs no caption A Daguerreotype camera that was all the rage a century ago looks crude and cumbersome to us





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today, accustomed as we are to the finest of precision cameras. The implication is of course that we feel mighty proud of our accomplishment But we must consider that had it not been for the Daguerres of vesterday. photography might never have achieved what it enjoys today

Window Reflections

HAT you see, you can photograph. This is not always appreciated by the amateur worker as much as it should be For example, a reflection in an open window of the sky opposite



Reflection

to that part of it which you happen to be facing, can be photographed, as it was in the accompanying illustration You will notice that the reflected part shows up bright and properly exposed, while the portions faced directly by the lens are overprinted This is, of course, due to the fact that the reflected buildings were lighted by the sun

The Lens Club

DESCRIBED as "the most unusual camera club in the world," the Lens Club, whose headquarters are at 165 West 46th Street, New York City, is out for members. The club hopes to serve as the national headquarters for the professional photographer and pioneer in the industry Its first objective, however, is to help its amateur members to perfect their technique and provide working facilities

Chief responsibility for organizing the club is credited to Herbert Mitchell, known as the "Photographer of Celebrities," and a list of distin-guished names constitutes the Advisory Board.

The club is characterized by its sponsors as "three clubs in one," combining the best features of the camera club, the social club, and the luncheon and dinner club. The clubrooms are the former home of the Motion Picture Club, occupying over 13,000 square feet of space

When completed, the announcement says, the club's facilities "will include a studio fully equipped for black and white and color work, darkrooms and finishing rooms, lockers and dressing rooms, showers, beauty parlor and barber shop, projection room and library, spacious and comfortable lounge, meeting room and exhibition room, dining room and kitchen, private bar, bridge and backgammon rooms." The formal opening will be September 1st, 1940.

Particulars may be obtained by writing to the club.

Cut Film Sizes

THOSE who use the so-called 21/4 by 31/4-inch cut-film size will be interested in the following letter recently received by this department from Lloyd E Varden, A R P S, of Agfa Ansco

"It has come to our attention repeatedly that there exists a general confusion in the two cut-sheet film sizes 21/2 by 31/4-inch and 6 5 by 9 cm These two sizes, although representing a difference of only .06 of an inch in width and 04 of an inch in length, cannot be used interchangeably. This applies both to the sheet film holders and to the film

"All sheet films are normally cut slightly smaller than their stated dimensions, in order to make them fit easily and smoothly into their holders The actual sizes are standard among American film manufacturers Discrepancies that have arisen in sheetfilm sizes have been due mostly to camera importations, but no trouble will result providing consumers make sure to get the right size for their particular camera'

WHAT'S NEW

In Photographic Equipment

Dejur Versatile Enlargers Series will take in negative sizes from 1 by 1 up to 5 by 7 Model now available takes negatives 1 by 1 to 21/4 by 31/4. May be used as enlarger, camera copying, camera for tabletop for photography, camera for photomicrography, camera for portrait and still life photography, for Kodachrome and other three-color work, for transparency projection at any angle Completely ventilated housing utilizes "Aero-Teck" design permitting only minimum heat to reach negative plane.

LAFAYETTE PORT-O-LAB KIT (\$8.89, complete) Complete darkroom set-up for developing and contact printing in handy airplane-style luggage carrying case. Maker suggests its use for developing and printing test prints while "on location," as well as convenience in small apartments where space is at premium. Kit contains Bakelite roll-film tank for all sizes from 35mm to 116 size roll film:

42 FULTON ST.

adway

ROOKS o

Amateur Photographers

New WAYS IN PHOTOGRAPHY, by Jacob Deschin Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another. It covers the whole range of amateur photography. discussing such things as trick pho tography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner. \$2.85.

So You Want to Take Better Pictures, by A. P. Peck, A friendly, face-to-face chat with the camera owner who hat his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to untilize it to best advantage. Over 200 pages, dozens of illustrations \$2 10.

UNIVERSAL PHOTO ALMANAC AND MAR KET GUIDE. How, when and what to photograph in order to make money ath your camera, where to sell different types of prints, \$100.

AMATEUR FUM MARING by George H Sewell, ARP.S. Useful to the beginner as well as the expert movie maker Tells about films, cameras, exposure. film editing, story telling with the camera, and so on, Illustrated. \$1 (4).

CHAMPIIN ON FINE CRAIN by Horrs Champlin. A complete hand-book on the entire subject of fine grain, in cluding formulas and how to compound and use them. \$2.10.

PHOTOGRAPHIC HINTS AND GADGETS, by Francie and Jordan, How to make all kinds of photographic accessories, from film clips to cameras to light ing equipment, and so on, 250 articles and nearly 500 illustrations. \$3.60.

PORTRAIT PHOTOGRAPHY, by H. Williams. Fundamental principles of composition and lighting, paving the way to satisfactory results in this particular branch of photography.

PHOTOGRAPHIC ENLARGING, by Frank-I'MOTOGRAPHIC ENLARGING, Dy Frant-lin I. Jordan, F. R. P. S. One of the most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salon-toinners, show the value of correct winners, show t technique, \$3.60.

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BOOKS : ---- CAMERA ANGLES-

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LITTLE TECHNICAL LIBRARY (50 cents per book) A second series of books on various phases of practical photographic work, just issued by Ziff-Davis Publishing Company Each volume covers a separate subject and is written by a practical worker in the field. The second series begins with book No 11. "Outdoor Photography." by Samuel Grierson, and concludes with book No 20, "Darkroom Handbook And Formulary" by Morris Germain, ARPS The others include No 12. "Indoor Photography" by Hillary G Bailey, FRPS, No. 13. "Flash Photography," by Russ Arnold, No 14, "Photographing Action," by Victor De Palma, No 15, "Manual of Victor De Palma, No. 15, "Manual of Enlarging," by Stephen White, A.R.P. S., No. 16, "Miniature Camera Tech-nique" by Fenwick G. Small, No. 17, "Photographic Lenses and Shutters," by Richard W. St. Clair, A.R.P.S. No. 18, "Photo Tricks and Effects," by Viscola December a.R.P.B. 25, 2018, 19, Jacob Deschin, ARPS, and No 19, "Selling Your Pictures," by Kurt S Safranski Each book is bound in stiff covers and contains about 25,000 words of text matter illustrated

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F-R DEVELOCHROME (\$75 per 4-oz bottle, \$ 75 per can special developer) Direct color toning developer for prints, created by Anton Bruehl, well-known American photographer Permits development of print to a colored image in any one of six colors Variations of obtainable colors end-BOOKS less, is manufacturer's claim, "de-

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16mm Filmo Triller For use with all Filmo 16mm cameras Features "usual centering" arrangement permitting titles to be centered accurately through viewfinder of camera Titler consists of camera carriage, title-card carriage, two swiveled refectors, each unit sliding upon connecting track and clamping firmly in any position. This can be used horizontally the properties of the properties of

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rect view finder, tripod socket, cable release socket, neck-cord eyelets, automatic exposure counter Accessories available leather eveready carrying case, filters—yellow, red, and green, sunshade, neckcord, cable 1elease, tripod

Photo-Ast Donesk (75 cents) Contains number of apertures of various sizes and shapes which can be further modified by rear plate into many series of patterns. Useful for localized spots, special effects, vignetting Diameter of dodger 14 inches Complete instructions printed on upper surface of dodger

....

THE ROUND TABLE Questions Answered for

the Amateur Photographer

- Q What characteristics are lost when an anastigmat lens is "stopped down" I know that the depth of field is increased Does the lens lose anything if focusing is accomplished by moving the front part of the leas while the back element remains fixed?—E J T.
- A Stopping down may cause a softening, that is, slight off-sharpness of the image, as compared with the image when focused at a larger opening, but this is usually of no practical consequence Besides, the advantage of depth of field, where this is revantage Opinion varies concerning the advisability of the method employed on some lens mounts by which the front element is moved back and forth in focusing while the back element remains tinmoxed. One of the best known cameras of today emovs a wide popularity both among advanced amateurs and professionals, who usually are very exacting, despite the fact that it employs this method of focusing
- Q. In using an exposure meter it is recommended that it be held near the object. Since the intensity of lighth varies inversely as the square of the distance I have not been able to figure out why a foot candle reading close to the object is just as applicable in calculating exposure time, and stops, when using the camera close up as it is when using it at several feet distance. Just why is there no distinction made?—G. O. I.

A The "square of the distance" which you mention has reference to the distance between the subject and the source of illimination and not the distance between subject and camera, Therefore, provided the light remains the same distance from the subject, it would not matter how near or how far you held the meter from the subject were it not for this important factor an exposure meter covers and the subject with the consequence that the resulting reading takes in not only the light reflected

from the subject but also that reflected from the surrounding area. If the meter's angle of view could be cut down so narrowly that, even at the position of the camera, only the light reflected from the subject would be included, there would be no necessity for approaching the subject closely, and the reading would be the same, cut a position.

- Q. Please state if the old type Petzval lens is achromatic. I want to use this lens for a terrestrial telescope even though the focal length is 24 inches.—A. T.
- A The Petzval lens is semi-achromatic, not fully corrected for color aberration, but sufficiently so for the purpose you have in mind
- Q I have been advised to use a Polaroid filter to eliminate reflection I notice that, when the filter is turned in the housing, the field darkens and appears to have a purplish east. Will his affect the natural colors on Kodachrome Type A film? Also, how effective is the filter for the purpose, and what changes in exposure time will be resulted?—SA R.
- A The darkening of the field is caused by a reduction in the amount of light admitted, and will not affect the color rendering of Kodachrome The effectiveness of the Polaroid filter in eliminating glare and reflection has been proved by many workers who have used this screen, as it is more properly called, both with Kodachrome and regular black and white the exposure time should be twice that required without the exposure time should be twice.
- Q Is there any type of successive flash equipment that would enable me to get several shots of wild life in the woods after dark within about 15 to 30 seconds?—G. W. T
- A By operating very quickly, you could probably get a few shots within this period with regular flash equipment and provided the camera film advance is of the automatic type If your flashgin head is of the bulb ejector type, speed would be facilitated. There is soon to appear on the market a multiple flash gun taking as muny as a dozen G E No 5 "Midget" bulbs, which may be fired successively one after the other in synchronization with successive films This will probably be most useful for your will probably be most useful for your
- Q Can you furnish information on home development of movie color film?—R. S. M.
- A The only motion picture color film that may be processed at home is Dufaycolor Details may be obtained by writing to the manufacturers, Dufaycolor Co, Inc, 68 West 48th St, New York City A drum recently placed on the market called the Graphic Reel cam be used for processing It has a capacity of 32 feet of 18mm or double 8mm film.

UNIVERSAL PHOTO ALMANAC AND MARKET QUIDE 1940

AMATEUR photographers who have been the control of the control of

Includes Articles Bu

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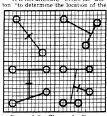


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Center of Impact

"It is not difficult," writes Mr Gor-



Upper left, Figure 1 Upper right, Figure 2. Lower left, Figure 3. Lower right, Figure 4

center of impact by averaging the horizontal and vertical locations of a group of shots by measuring from suitable vertical and horizontal reference lines, such as the edges of the usual paper target, but this process usual paper starget, but this process usual paper starget, but this process agroup of the stargeting purposes, a group of shots is necessary, and the smallest group, of course, is two, which, while more conclusive than a single shot, is still rather small. The center of impact found, as obviously it lies exactly half the starget of the starg

"This principle is easily and conveniently applied to large groups. Three shots form the smallest group which is reasonably satisfactory for targeting purposes. To get the center of impact of such a group, first find the mid-point of the line joining any two shots. The center of impact for the group lies one third of the way along the straight line from this point toward the third shot. (Figure 2), Three-shot groups will do fairly well, Three-shot groups will do fairly well, but four-shot groups are better and can be measured quite as really Simply join any pair of shots with a straight line, and the remaining pair likewise. The mid-point of the straight line joining the mid-points of these two lines is the center of impact of the group (Figure 3).

"The orthodox five shot group also can be measured very easily, so the shooter who must have a group of this size can fire his five rounds cheerfully. letting them fall where they will To measure the group, first locate the center of impact of any four shots as above described. One fifth of the way along the straight line from this point toward the fifth shot is the center of impact for the whole group (Figure 4), and this method can be applied to groups of any size, by working in successive steps. A geometric principle, the process boils down to this Consider the individual shots to be small bodies of equal weight lying in the plane of the target. The center of impact of the group is the center of gravity of this system of like bodies Figures have been drawn on coordinate paper so that skeptics may readily verify the plotted location of the center of impact in each case by finding the average horizontal and vertical locations of the various shots A graphic check, also, may be made in all but Figure 1 by starting with other pairs of shots"

Back-Woods Are Closer

Fit were not for technological progress in the realm of marine motors, a lot of us who like to angle for the big ones back in the wild country might find ourselves handicapped in fulfilling our piscatorial desires True, the ancient and honorable method of cance travel is still to be relied upon and is particularly applicable to the fisherman whose budget is more limited than is his time. The airplane is our modern way of getting into the bush, but it does reveise the aforementioned budget-time premise. Due to scientific advances in outboard motor manufacture, however, we now have a middle-of-the-road method which saves time, costs next to nothing and is as reliable as the powerful motors which wing over forest and lake Today we can answer "the call of the wild" just as we always have by stowing our duffie into the old canoe But, by adding only a relatively few pounds to the total weight of our outfit, we can save lame

muscles, blistered hands and many hours—in which to get in more fishing. Here's how it's done

Lev's assume we're headed for the Lake of the Woods sections, or north-western Quebec, where chains of lakes connected by small streams or short portages will lead to the lair of the muskie, the wall-eye, or the great northern. If we take along an Elio Cub outboard motor, for example, made by Evinrude Motors, we add only 8½ pounds to our load A special



With an 8½-pound outboard motor and a few gallons of fuel, the hunter or fisherman can save much back-breaking work

bracket for canoe attachment is a couple of pounds more and packs easily. The motor runs 10 hours on a single gallon of fuel, will propel two men and their duffle in a canoe up to five miles an hour. As a conservative figure let's say we average 3½ miles per hour on lake travel, which comes to 35 miles for our first gallon of gasoline consumption and is probably a greater distance than a couple of citysoftened outdoorsmen can hope to cover by paddle on the first day out Without straining our backs too much we can pack in four extra 1-gallon tins of pre-mixed motor fuel, a total weight at the start of about 32 pounds, and we are assured of a minimum of 175 miles of motorized canoe travel Based on our own experience of many thousand miles in a canoe, upstream and down, with the wind and against it, we believe a 25-mile-a-day average by paddle is about all two softmuscled men can hope to accomplish If we cover the same distance by motor in five days, instead of the seven required by paddle, we'll have two days more in camp, and it has cost us a little over \$25 for the motor and about two cents an hour for its opera-

As noted above, the modern outboard motor is a far cry from its early ancestors in power, dependability, and weight. With Evinrude motors, for instance, the "dynamometer test" is used to establish power ratings. To insure absolutely impartial results.

tion

Evinrude has all models tested by The Pittsburgh Testing Laboratories, whose results are submitted to The National Outhoard Association for final certification before being used by the manufacturer Dependability and further protection are afforded through a policy of measuring horsepower at engine speeds recommended for constant service, rather than peak horsepower attainable, thereby assuring long hours of continuous and uninterrupted operation As to weight, anyone who used to strain his back in order to install an outboard of 20 years ago will recognize the portability and adaptability to fishing trip usage of an 8½-pound motor which develops 5 NOA Certified Brake HP at 4000 RPM Yes, in these days the back-woods and the big fish are there, thanks to American ingeniity and scientific progress in outboard meter building

POT-SHOTS At Things New

MABLIN FIREAMS COMPANY answers the country-wide demand for a rifle to use with the miniature clay anget games, like Mo-Skeet-O and Turgo, by developing a Recess Choked, Smooth Bore 22-cailier single-shot With this new Martin method of borning, it is said that the control of shot distribution gives the best potential target breaking spread at any distance from 30 to 45 feet, with as wide a pattern as possible without holes through which a target could esque through which a target could esque before through which a target could esque Boil Action, Smige Shot Rifle Soil Action, Smige Shot Rifle

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THE PARKER-WHELEN COMPANY, INC, formerly National Target & Supply Company, in presenting its 5th edition of Colonel Townsend Whelen's "Gun Handbook and Catalog," offers to the shooting fraternity one of the most umes on firearms we have ever seen Colonel Whelen, who needs no introduction to American shooters, had as his editorial associates three men whose names have long been synonomous with expert knowledge of guns and ammunition, namely, Colonel Julian S Hatcher, Colonel H P Sheldon, and Major Charles Askins Each has contributed a fund of factual information from the fields in which he is a nationally known authority Colonel Whelen wrote the sections devoted to Small Bore Rifles, Game Rifles, Telescope Sights for Rifles Pistol Marksmanship, Colonel Hatcher has exhaustively handled Revolvers and Pistols, Colonel Sheldon and Major Askins covered the shotgun field and marksmanship with the scatterload There are also articles on cleaning and cleaning materials, receiver sights and binoculars, reloading tools, clothing and outdoor equipment. gunsmithing, and a particularly help-ful article entitled, "Useful Informa-tion for Shooters" The book is profusely illustrated, includes prices of all equipment shown and sells for only 25 cents a copy

SHAKESPEARE COMPANY, which for many year has been supplying in-numerable anglers with "what it takes" to take the fish, offers an exceptionally fine 1940 catalog If you haven't obtained yours, we suggest you do so before the fishin' season is a minute older, and then devote a pleasant hour or so to its perusal pleasant hour or so to its perusal voul' find it entireng, helpful, constructive, and educational, particulated by Tony & Georgia methods used by Tony & Georgia (hearing the property and Fig. 2).

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A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

THING of first importance in a telescope is functional excellence, of course, but it is, however, nearly always possible, without compromising his quality, to combine attractiveness By attractiveness some may mean decorativeness. This may have

near decoratives. This may have

Figure 1: Hopkins' pleasing design

its place provided it does not run to over-decorativeness and to "gingerbread" Perhaps, however, the best source of that something which gives beholders an instinctive feeling of satisfaction in any machine or structure is good proportion of parts and of the whole

of the whole

It is a long time since this department has received photographs of so
well proportioned a telescope, whether
made by amateur or professional, as
the one shown in Figure 1 This 6"
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"The knowledge required to build his telescope," Hopkins writes, "came entirely from the Scientific American books "Analeur Telescope Making" and Amateur Telescope Making" and Amateur Telescope Making and in Martin and M

"Atop the pedestal, the axle housing, from a Nash car, is slantingly welded on The R A shaft turns on tapered roller bearings and is drilled through, so that Polaris can be sighted through a ring welded on the declination shaft. The declination shaft also turns on roller bearings mounted in a Model A Ford axle housing.

"The R A setting circle is graduated to units of 10' and has a vernier to read to 1', the declination circle to 1", with vernier to 5'

"The Bakelite tube can be turned in a split sleeve and is guided by two brass rings that were not yet on when the photograph was made The mirror is Pyrex, of 48" fl, and is supported in the cell by a split brass ring with a cork insert. It is held by six screws around the edge, and behind by a triangular plate with three cork pads. The prism holder is universally adjustable "Accuracy in the working parts was held to a very high degree, the limits held as close as possible with precision measuring instru-

"The whole thing handles easily and can be carried by a delicate woman, with the help of a strong man"

ments

the help of a strong man"

Not every amateur has access to fine machine tools



Figure 2: Bohm's observatory

or has had a chance to learn their use Yet good proportion does not require these things, in fact, some who have them do not attain to it Take, for example, the counterweights of this telescope, even though this is not a very vital part. If we were to make these only a few percent fatter and stubbier, or else skinnier and longer, the telescope would seem to one judge, at least, to have lost its fine figure, just as your scribe has Maybe Hopkins just happened to have metal of these proportions but our guess is that he planned it so, as he did with other details

STONE is the chief material from which Anton Bohm, a monument maker. Apex Monument Works, 6815 W 29th Avenue, Edgewater, Colorado. built his observatory (Figure 2) Its granite, brick, and stucco-lined wall is 12" thick and 8' feet high (including the 2' part that is hidden) side diameter is 1212' Inside are three stone steps rising 24" to the concrete floor, with a trap door to cover the stair well, thus forestalling broken necks. In front is a low surrounding wall to contain earth for Mrs Bohm's flowers and vines Bohm says Mis Bohn helped him with the observatory by mixing concrete. The tele-scope pier goes 8' below the surface Absolutely no vibration is noticeabla

and the done is financed with 25/32 uniber and overed with 3/18° build-limber and overed with 3/18° build-limber and overed with 1/18° build-limber and overed with linaced oil 17 this, heavy canvas stips were added over the joints and the entire surface was given three coals of white outside paint. The shutters (Figure 3) are self-explanatory, also satisfactory. The acoustics misde the done is three especially for people with squeeky voices, Bohm states.

A lead cable from the residence conducts current for light and drive A temporary telescope is in use while Bohm patiently proceeds with a 12" reflector whose tube is shown in Figure 4 Each of the eight main struts of aluminum was cast in one piece from patterns previously made and used by Carroll C Spencer, of the Spencer Laboratories, Denver "Don't think the foundryman didn't cuss when casting the pattern eight times, Bohm writes "He had to lie awake nights to figure out a way to pre-pare the mold so that the castings with about "4" shrinkage, would not break as they cooled" To clean up these castings, Bohm filed 15 hours on each strut! The rings are 14" brake drums from old Essex cars. The profile of the tube gives a feeling of nice proportion-or have we gone entirely mad on proportion?



Figure 3: Petal type shutters

- TELESCOPTICS ---

N describing the Goethe Link Observatory, at Brooklyn, Ind . in the June number, Victor E Maier, Director of the Observatory, mentioned that the Hartmann test of the 36" mirror was reduced by Dr James Cuffy of Indiana University, Dr. Cuffy writes that, after becoming thoroughly conversant with everything in "ATM" and "ATMA," he was sur-



Figure 4. The leg-shaped tube

prised to find that amateurs had almost no appreciation of the value of the Hartmann method of testing He thinks this may have resulted from the brevity of the chapter on this test in "ATMA." so he wrote up the method as he used it, including shortcuts which he says simplify it enormously His account, which ought to be in "ATMA." follows

"The Hartmann method of test-ing optical surfaces has, apparently, been avoided almost entirely by the ampteur astronomer The avoidance may be due largely to the photographic technique involved, but also I believe, to the implication ('ATMA,' page 109) that the Hartmann test is one applied to finished mirrors alone Possibly the following paragraphs will serve to point out its value in testing a mirror at any stage of the figuring process

The advantages of the Hartmann method are 1 Its complete objectiv-ity, there is no judging of equal brightnesses for patches of light separated by considerable distances The measurement of a radius of curvature is reduced to the measurement of a distance on a photographic plate 2 The greater number of zones that may be tested at one time. To test numerous zones visually requires time, and fatigues the eve. whereas the Hartmann test gives the radii of as many zones as desired with a minimum of effort 3 The more detailed knowledge of the deviations of the surface from parabolic, or other required surface, that results from testing many zones of the mirror

The disadvantages, as seen by the uninitiated, are the need for large numbers of photographic plates, especially since, in its conventional form, each test requires two plates, and the need for a comparator in measuring the plates These objections, however, may easily be met I am confident that, once the amateur has tried the Hartman test, he will be convinced of its superiority over visual zonal testing

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"In Hartmann testing, we place a perforated diaphragm before the mirror The periorations are customarily placed along eight different axes of the mirror The diameters of the holes are usually 1/400 of the distance from diaphragm to plate, and the centers of the holes are separated by approximately 21/2 times the diameter of each hole Naturally, it is only when testing for astigmatism that one measures all the axes of the mirror The geometry of the test is shown in Figure 5 We are interested in obtaining the distances, d., from the plane of the photographic plate of the points where the rays from a given zone cross the optical axis

"The first simplification we may make (see Danjon et Couder, 'Lun-ettes et Télescopes,' p 507) is to dispense with one of the plates, and to substitute for it the diaphragm itself (at s₁) Since we have constructed the diaphragm with reasonable accuracy, we know immediately the values of a, or the separations of the two holes corresponding to the given zone d, is then the distance of the diaphragm from the pinhole, or, with sufficient accuracy, the radius of curvature of the mirror Thus, it is sufficient to take only one plate, inside focus, and to compute once and for all the factors d1/a, by which the separations on the photographic plate, a,, must be multiplied to give the distance from the plate to the intersections of the rays with the optical axis

The second simplification lies in the method of measuring the plates Since the Hartmann pattern is usually only 1/2" in diameter, we may use an ordinary photographic enlarger to enlarge the particular row of spots in the pattern to be measured up to about 10" long (strips of bromide paper 1" wide are sufficient) We then measure the positions of the spots with a good ruler The scale of the enlargement must be known, and a simple method of determining the enlargement factor is to place a small piece of scotch tape of known width on the emulsion of the plate near the row of spots to be measured We may then divide the separations measured with the ruler by the enlargement factor, in order to obtain the desired values of the a's on the plate

"One could, of course, avoid photographic work entirely in making a Hartmann test by providing himself with an eyepiece micrometer having illuminated cross-wires, thus making settings of the cross-wires on the image of the Hartmann pattern directily without bothering to photograph it

"It is important that the Hartmann diaphragm he held in a plane as close to the mirror as possible, and that the plate be perpendicular to the optical axis If the mirror is of high aperture ratio (f/4 or less), the value of r for the zone heing tested will differ slightly from the value of r measured on the screen, because of the inclination of the rays and the fact that the disphragm is not in contact with the converse surface. Ordinarily, however,

we may use r as measured on the diaphragm for computing the paraholic radii, r'/R

"The writer has used the Hartmann test as described above in testing the 85°, 1/5 mirror for Dr Goethe Link's observatory (Brooklyn, Indiana), and has found the method convenient and accurate He had, however, access to

a good measuring machine
"Having obtained the values of the
radii for a number of zones of a mirror,
we may compare them with the computed values for a perfect mirror and
predict the performance of the mirror
in actual use Thus, we may compute

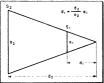


Figure 5 Geometry, Hartmann

the value of the Hartmann criterion, t, which is the weighted mean radius of the confusion disk, each zone of the mirror being weighted according to its light gathering power, or its circumference, since the area of any zone is proportional to its circumference. The value of t is given by

$$t = \frac{200,000}{F} = \frac{\sum r \Delta F}{\sum r}$$

where 200,000 is very nearly the number of seconds of arc in a radian. F is the mean focal length, r is the distance of the zone from the optical axis, and ΔF is the axial error from true focus. All the Δ Fs are taken as positive numbers, that is, we use their absolute rather than their algebraic values. If a mirror is to perform well, its latriman criterion must be less than its theoretical resolving power, or $45\,$ seconds/aperture

"Most of the large mirrors at present in use have values of t between 01 and 0.2 A mirror larger than 24" in aperture, and having a value of t less than 05, is just satisfactory for photographic work, but unsatisfactory for visual work. In fact, seeing conditions combine with photographic graininess and the diffusion of light in the emulsion itself to make star mages less than 0 035 mm in diameter rare, while under ordinary conditions the images obtained with a large instrument are usually between 0 05 and 0 10 mm, in diameter. It is thus evident that the demands for high optical quality are about five times as stringent in the case of a telescope to be used for visual work as for one intended primarily for photography. And therein lies the reason why the average astronomer is able to obtain plates of value on

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TELESCOPTICS-

nearly every clear night. The situation is perhaps best described by saying that seeing conditions are seldom too bad for photographic work, while they are seldom good enough for visual work, at least with high powered evenieces."

WE keep hearing of more and more men who once were ordinary amateur telescope makers and who sweated over their first 6" mirrors, "even as you and I," now finding their permanent life work in ontics as the ultimate outcome Ralph Dietz is with the Mt Wilson shops, two amateurs now are pros with Bausch and Lomb. while around New York are several who are regularly employed in professional shops What is called the "Optical Division" of the American Astronomical Association is that fraction of The New York City amateur astronomers who enjoy getting their rougey hands on hunks of glass and converting them into telescopes and other things optical Its organizer was Lew Lojas, and he, for the past three years or so, has earned his living as an employed professional He is with the Kollmorgen Optical Co., 767 Wyeth Ave, Brooklyn, N Y, where he pol-Hanna, another Optical Division amateur, now is also with Kollmorgen. edging and inspecting lenses, while Walter Howland, from the same amateur group, is a Kollmorgen computer

Working in the Jersey City shops of the Perkin-Elmer Corporation, of 90 Broad St, New York, N Y, 1s Daniel E. McGuire, a typical amateur from a typical Ohio small town who went to the great city and who is running the polishers and correcting objectives, also Stanley Brower, who does blocking and works on magniflers, eye lenses and microscope objectives. We hear there is an opening for one more good man in these shops

In Keuffel and Esser's shops, at 300 Adams St , Hoboken, N J , is another optical Division man, Carl Grosswendt, doing optical inspection

Some of these men and others who may choose similar work stand a good chance of becoming leaders in the optical industry in later years

We have received a letter from Frank A Eaton, of the Bausch and Lomb Optical Co., Rochester, N. Y., who mentions the comments about war emergency optical tobs for amateur telescope makers, made here last month, and says "We are interested in knowing sources from which applicants may be obtained in the future While it is not our intention to encourage more people to come to the plant for interview at this time since the numbers now applying far exceed any future employment we shall have for them, if the amateur telescope makers will merely write to us. so that we have their names and addresses on record, with an explanation of what they have done with optical grinding and polishing, that will be sufficient material for us to use in seeking later interviews'



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Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

Notice

A PATENTEE who does not manufacture and sell the patented article may recover profits and damages from an infringer even prior to the time that actual notice of infringerment is transmitted to the infringer

Much confusion has been caused by the provision of the statute which states that it shall be the duty of all patentees making or vending a patented article to affix thereto the required patent notice consisting of the word "Patent" followed by the number of the patent. The statute provides further that "in any suit for infringement, by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article so patented

It will be readily understood that where a patentee manufactures and sells articles under his patent he must affix the proper patent notice to the article in order to recover profits or damages from the infringer Should he fail to affix the notice to the patented article he can only recover profits and damages accruing after the date on which notice was transmitted Confusion has existed however, as to those instances where the patentee did not manufacture and sell the patented article Some courts were of the opinion that profits and damages could only be recovered after the date on which actual notice was transmitted, while other courts expressed the opinion that no notice was necessary

This confusion was dispelled by a decision of the United States Supreme Court which, after reviewing the history of the statute, concluded that it was only intended to apply to those instances where the patiente manufactured and sold articles under the patient. Where no manufacture and patient, where no manufacture and cover damages and profits, the Court held, even though no notice of infringement was transmitted to the infringer.

Early American

When an application for the registration of a trade mark is approved and passed by the Patent Office it is published in the Official Gazette prior to the registration of the mark Anyone belleving that he would be damaged by the registration of the mark may. within 30 days of the date of publication, file a notice of opposition to the registration When the opposition is based upon a prior trade mark owned by the opposer and the opposer charges that there is a possibility of confusion between his mark and the mark sought to be registered, the Patent Office resolves all doubts as to similarity between the marks and as to the possibility of confusion in favor of the the presistanciant the applicant for the presistanciant the applicant for the presistanciant.

This principle is illustrated by a recent decision involving the trade marks "Elgin American" and "Early American ' A manufacturer attempted to register the trade mark Early American" for cosmetics and saponaceous materials The registration was opposed by the owner of the trade mark "Elgin American" which was applied to vanity cases, face powder containers, and containers for other cosmetic materials. The Patent Office and the Court of Customs and Patent Appeals concluded that there was a possibility of confusion be-tween the marks and, applying the rule that all doubt should be resolved in favor of the prior user of the mark, refused to permit the registration of the mark "Early American" for cosmetics and saponaceous materials

Impatient

THE processes of the law are slow and income sharp and in

The alleged infringer of the patent then brought a motion to dismiss the suit on the grounds that the Court did not have jurisdiction because no patent was in existence at the time that the suit was filled. The Court granted the motion and dismissed the suit, and did not correct the defect existing at the time that the suit was filled.

Trade-Mark Prints

THE manufacturer of a dress fabric containing a design based on well-known trade marks enjoined a competing manufacturer from selling fabrics containing similar designs. The

..... LEGAL HIGH-LIGHTS

original manufacturer was licensed by the owners of certain well-known trade marke to use their trade marks under controlled conditions as designs for dress fabrics. The infringer used the same trade marks without permission from the owners thereof The Court pointed out that the copying of a fabric design which is not protected by design patent cannot be restrained. However, in this instance the copying involved the use of well-known trade marks without the permission of the trade-mark owners. Under these circumstances the Court held that the unauthorized use of the trade marks as a design for a dress fabric constituted unfair competition and an injunction and an accounting were awarded

Double Identification

An article of commerce may bear two trade marks and each mark may be separately subject to protection against infringement. This is illustrated by a suit involving the infringement of the trade mark "Friendly" for shoes The manufacturer had used the trade mark "Friendly" together with the trade mark "Jarman" in the sale of its shoes The defendant, a retail dealer, used the trade mark "Friendly" but not the trade mark "Jarman" in connection with shoes coming from another manufacturer The dealer con-tended, among other things, that the trade mark "Friendly" was invalid because of its use with the other mark It is also contended that to be guilty of trade-mark infringement it would be necessary to use both of the manufacturer's trade marks. The Court ruled that the trade mark "Friendly" was valid, that it denoted the manufacturer's goods, and that the use of this mark by the retail dealer constituted infringement

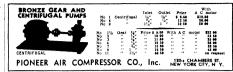
Frozen Lollypops

The ice cream lollypops which are so popular with children were m-volved in recent patent ligitation A suit was filed against a manufacturer of such lollypops charging infringement of two patents, one relating to the ice cream lollypops per se, the other to the method of making them

In making the lollypop the stick was inserted in the ice cream at atmospheric temperature while the ice cream was in fluid condition. Thereafter the ice cream was frozen with the result that it adhered to the stick

It was claimed by the patentee that this operation involved invention. The Court, however, declared the patent invalid, referring to the ageold custom of children of inserting, sticks in a snowman and permitting them to freeze therein. In this connection the Court stated

"It is childhood knowledge that the stick for a nose in a snowman, inserted in the afternoon, is so frozen to the icy snow particles, that, in the morning, young fingers cannot pull if out"

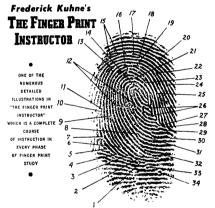


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TO THE co-ordinated action of all totagories of warships, in fleet operations, must now be added co-operation of and with the Air Force of the Navy Alreraft go with the fleet and operate with it offensively and defensively In our cover, an official U. S. Navy photograph, battleships and aircraft are shown in recent maneuvers

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MYTH? PART TRUTH?

AT LAST a way to put the Lost Atlantis tradition to a scientific test has been found. Readers will recall how Plato recorded a story, which in his time was already 8000 years old, that a wast land lying west of Gibraitar and containing a great empire. In a day and a night sank beneath the sea The belief, therefore, that the rich cities of a civilization more advanced than our own lie today in all their arrested splendor burns bright in the souls of modern Atlantis cultists Is that tradition entirely mythica?

Lying 12,000 feet beneath mid-Atlantic waters is the Atlantic Ridge, a vast submerged plateau which some Atlantican believers identify with the Lost Atlantis. Why couldn't this have sunk' Do not parts of the earth's crust rise and fall, as geologists commonly point out' Aside from the fact that few geologists believe large areas founder deeply, the unusual feature of the Atlantis tale is the sudden submergence it calls for. Geologists deny its possibility

Within recent years, however, new evidence has come to light that may encourage the Atlanteans Perhaps, instead of itself sinking, the Atlantea Reinage, sustead of itself sinking, the Atlantea Ridge plateau was laid bare by a subsiding sea and later flooded again by a rising sea. The discovery of large submarine canyons far below present sea-level now leads some geologists to believe that these were excavated by rivers flowing on what then was dry land. To account for this apparent anomally, they assume that a great deal more of the earth's water was locked up as glacial age ice than has previously been thought. One geologist, A. C. Veatch, estimates sea-level in glacial times at 12,000 feet below present sea-level. This fits in nucley with Atlantean tradition.

If the waters gradually withdrew during 50,000 years of the last glaciation, the Atlantic Ridge might for many millenia have had a population. Finally, as polar ice melted away, the seas would have risen and the area would have been submerged—not, however, overnight or even over a lifetime—something geologists refuse to accept. (Incidentally, the inhabitants could not have been able to distinguish the rising sea from a falling land) A tradition of sinking would have started among those who departed the area, and before long the story would have picked up trimmings, most certain of which would be a submergence with dramatic suddenness, for this would be too good a supplied detail for man to forego.

Methods of surveying the sea-beds with previously unhoped-for precision, by employing the some depth finder in connection with-remarkably exact methods of measuring horizontal distances with actual tapse (wires), have recently been developed and proved good In many places such surveys reveal a thing that makes geologists raise their eyebrows—a complex pattern of typical land-surface, stream-resion channels. And now Capt. Gilbert T. Rude, of the United States Coast and Geodetic Survey, in the Proceedings of the United States Naval Institute for August, proposes that such a survey of the Atlantic Ridge be made.

Capt. Rude does not propose this merely to test the Lost Atlantis tradition, for it would have other and greater values to science, but he does point out how it might tend to settle this old question. If a typical pattern of stream-erosion channels—in other words,



valleys—were found covering the Ridge area, this would tend to favor the Atlantis hypothesis. If only typically smooth, unchanneled sea-bed topography were shown, Atlantis would look still more like pure myth than it already does to most scientists

However, even if the eroded land-forms were found, the real essentials of the Atlantis hypothesis, as its mystical proponents prefer to have them—that is, the great "empire" and the civilization "superior" to those of our own times and all that kind of thing which mystics and occultasts dearly love—would scarcely be given encouragement; unless perchance the dredges of the Survey were to haul up from over one mile beneath the surface a golden throne and some things we benighted moderns could not yet understand, perhaps an atomic energy machine—A G I

FEEDING FOREIGNERS

UNCLE SAM is being urged by some well-meaning but near-sighted citizens to feed and clothe the needy of European countries which are now under the domination of the German war machine. Should such a plan be put into effect, it would surely prolong the present conflict and might even be the instrumental factor in tupping the scales in favor of a Nazi victor of a Nazi victor.

At the present time, Germany is reported to be stripping the invaded countries of all available food supplies, which indicates the effectiveness of the British blockade. Regardless of any promises which might be made by Germany, food and clothing supplied to invaded countries undoubtedly would be seized by Germany as a matter of self-preservation. The fact must not be overlooked that should the present blockade continue to be effective, the obvious strain on the resources of Germany in feeding itself as well as the populace of conquered countries might bring about an early cessation of hostilities.

While we have every sympathy for the sufferings of the people of Europe, we should steel ou selves to the fact that to rob Great Britain of the effects of one of its most potent forces—the blockade—might be the means of bringing about a far greater catastrophe

A large amount of money has been solicited from the people of the United States for the purpose of aiding the destitute of foreign countries. In fact, one organization publicizes the fact that it has available many millions of dollars. There are in the United States thousands of people who are in absolute need and worthy of every charitable consideration. Would it not be a good idea to use the funds collected for foreign assistance for the and of our own countrymen who are unable, to obtain the necessities of life from other sources?—O D M

50 Years Ago in . . .



(Condensed From Issues of October, 1890)

WAR BALLOONS—During the last sixteen or seventeen years, the Dutch government has been carrying on a more or less active war with certain tribes in Acheen, a district of Sumarta, the tind largest island of the world, and with this view have dispatched a military ballooning contingent, under the direction of Mr Percuia Spencer, an English aeronaul, to Kota Rajah, the fortified capital of the unconquestion of the concorned contingent and the contingent of the unconcept of the continuent of the c

PACKAGE TRANSPORT—The portelectric system is intended for the transportation, not of passengers, but of mail and express matter only, at rates of speed approximating two miles per minute, the steel car being drawn along its confined path at this high rate by the pull of



numerous solenoids through which the track is laid, each coul exerting its power for a short time only as the car approaches it. The passage of the car completes the tractic circuit between the upper and lower rails through th solenoid in advance of the car, and the car is thus pulled in into the coil until it is immostly through the current is cut out and transferred to the next coil in advance of advance.

TELESCOPE—The glass for one part of the great fortymich objective of the new Southern California observatory has been received by the Clark Brothers, of Cambridgeport, Mass — The telescope is to be mounted in an observatory upon Wilson Peak, of the Sierra Madre Mountains, 12 or 15 miles back of Los Angeles, Cal

GUN POWER—The range and penetrating power of modern rifles are tremendous The six-inch rifle will hurl its projectile through ten and a half inches of wrought iron a thousand yards from the muzzle The eight-inch rifle will piece sixteen and three-tenths inches of iron at the same distance The ten-inch rifle that the rejuventable Misantonomoh will carry will send its missile through the control of the property o

METAL VALUE—The price of platnum has recently advanced very greatly, until now it is nearly equal in value to gold in July, 1899, the price was \$8 an ounce, six months ago it was \$14, and at this writing it is \$20 an ounce, while gold is quoted at \$20.70 (sic). This rapid rise in the value of the metal is due to the steadily increasing demand from the manufacturers of electrical apparatus.

CHOLERA—Advices received from Tokto, via Yokohama and British Columbia, contain intelligence of the terrible outbreak of cholera which has taken place in Japan, by the ravages of which upward of 200 deaths were occurring daily.

ANCIENT ROSE—At Hildesheim, in Hanover, there is a celebrated rose bush, the oldest in the world Charlemagne himself planted it more than a thousand years ago in commemoration of the embassy received from the caliph of the Thousand and One Nights, Haroun al Raschid

EXHIBIT—The 59th annual exhibition of the American Institute opened, in this city, on October 1, and is now in progress. Among the photographic novelties is the slot or machine for taking photographs. On sitting in position and dropping "a nickel in the slot" and executing some manufacture of a photography of the sitter is passed out.

PRECIOUS—Uranium was unknown a century ago, but a lode has been found in a mine in Cornwall, England. It sells for \$12,000 a ton

SHIPS WITHIN SHIPS—A floating island mode of steel. 1,000 feet long, 300 feet wide, and drawing 26 feet of water—such is the type of ship as described by Sir Nathaniel Barnaby. Constructor Barnaby would load and unload his ship in midstream by lighters, and, instead of breaking their bulk, would take them aboard, hull and cargo, for his plan includes a clear sheet of water for them 'tween decks, a miniature harbor into which they may be floated at one port and floated off again at another Once the lighter fleet containing the ship's cargo is properly arranged aboard, the floating basin can be pumped dry and all comfortably stowed for the voyage—the sea being let in again after the ocean has been crossed, and the cargo thus distributed in many bottoms floated shore

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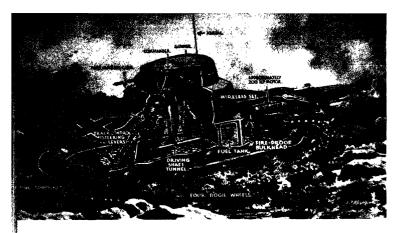


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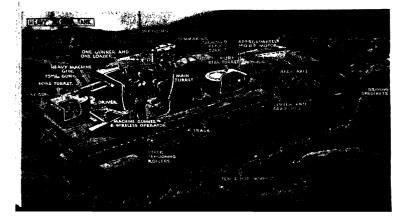
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ECHANICAL SHOCK-TROOPS

moners land warfare, as conceived by the Germans, puts the tank on the second line of offense, to follow the spearhead of the attack—the dive-bomber. Having built vast numbers of these mobile, light artillery units, the Nazis have been able to sweep irresistibly across several countries. Several types of tanks are employed, including the two shown here; a light tank, long type; a light medium type; and possibly larger types. The short, light tank, above, mounts machine guns, carries a crew of three, and has a road speed of perhaps 30 miles an hour the long, light type mounts a machine gun and either 37-mm or standard anti-tank guns. The light medium tank is similar to the long, light type, but has a look-out hatch and heavier gun. The heavy medium, below, mounts a 75-mm gun in a turret, several machine guns, as crew of seven. Drawings from The Illustrated London News.



BOMBERS PLUS BATTLESHIPS

Both Are Needed For Co-Ordinated Effort

A. B. VOSSELLER

HEN the editor of Scientific American requested this article, he suggested the title "Bombers versus Battleships." Since the days of General William Mitchell, of the U. S. Army Air Corps, controversy has raged upon this subject and many articles purporting to analyze the problem of bombs, or bombers, versus battleships have appeared. Events abroad have intensified interest in this question and it is, therefore, quite understandable that the editor should think his readers would be interested in the subject.

In the writer's opinion, however, no more dangerous argument bearing on national defense problems than this very question of bombers versus battleships has ever occurred In the writer's view, it would be about as easy and conclusive to present a discussion upon the subject of brothers versus sisters or, to select an analogy closer to the question, infantry versus tanks. whereas the self-evident fact is that we need both The real question which every public-spirited officer of the Army or Navy, or for that matter, every public-spirited civilian, is interested in, is the broad question of adequate national defense rather than any narrow question of the transient superiority of some particular arm over another arm of the national defense, and that under certain given conditions Hence the title selected and used above.

There never has been any argument, to the best of the writer's knowledge, about the fact that a bomb, if it hits, will damage a battleship—or anything else which it may strike. There has been a great deal of discussion, some of it quite

The opinions or assertions contained in this article are the private once of the writer, and are not to be sometimed as efficient or reflecting the views of the

acrimonious, as to whether one bomb will sink a battleship and if not one bomb, then how many That type of argument proves nothing, beclouds the issue so far as the uninformed are concerned, and is generally destructive to the best interests of our national defense



The fact of the matter is that a battleship, or any other warship, is a very strongly constructed vessel and the damage which will be sustained by a hit from an aerial bomb will be largely determined by the location of the hit and the particular circumstances prevailing at the time

The whole controversy of bombers versus battleships is strongly reminiscent of similar controversies which took place years ago concerning the relative merits of battleships and destroyers, and likewise battleships against submarines At that time the proponents of the battleship stoutly maintained that the battleships were superior to the destroyer and the submarine. each with its torpedo; and the proponents of the destroyer and submarine were equally as insistent that their pet weapon had rendered the battleship obsolete. It should have been obvious then, as it is to all thinking people today, that neither was "superior" to the other but that, as in the controversy of the battleship and the airplane, new and highly destructive weapons for use in naval warfare had been developed.

It is submitted as highly significant that there has never been any

great controversy in the Navy itself over the relative value of the bomber and the battleship and that the state of this controversy has been thrust upon the Navy by others. The flyers of our Navy are not only naval avaiors; they are also seagoing naval officers who understand the inter-relationship between the various parts of the Navy and therefore would no more sacrifice battleships than they would the Navy's avaiton.

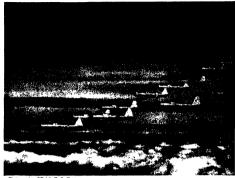
This is believed to account, in large measure, for the eagerness with which aviation was seized upon as a tool by officers of our Navy, once its teething days were over and the future stature of aviation became apparent to the discriming the first open and the strongly pushed and highly developed with the further result, today, that U.S. naval aviation is pre-eminent in all its phases over every other air force in the world.

DEVELOPMENT has many times seemed maddeningly slow to the officers of naval aviation, but, as we regard the status of things at present, we find that, slow though it may perhaps have been, it has nevertheless been sure and steady and certain. The U S Navy today finds itself with aircraft carriers so far ahead of any others in the world in operating technique, training of pilots, suitability of aircraft carried, and, most important, training with the Fleet, that there is no comparison possible. In the same way, the long-range patrol bombers of the U. S. Navy are incomparably better in every respect than those possessed by any other air force in the blrow

We have now, and have long had, more planes of this type than any other air force and newer and finer ones, embodying all the lessons from our wealth of experience in the past, are under manufacture and soon to be delivered The dive bomber, which has demonstrated its frightful power so overwhelmingly in the hands of the German air force, was pioneered, developed, and perfected by the U S Navy and today only the Germans and ILS naval aviation have real dive bombers All our battlechine and criticare carry aircraft to be launched by catapults from their parent vessels and these airplanes also have no peer in any air force in the world. The pilots who fly them have been especially trained and indoctrinated to work with their parent vessels and it is merely a matter of routine in the Fleet to use these aircraft for scouting, submarine searching, and spotting of gunfire

It will be seen from the above brief summary, therefore, that technically, and in the development and adaptation to naval use of new ideas, naval aviation has led the world. Important and encouraging though this progressiveness and progress are, they are by no means the whole story, nor even the most important part.

The organization of the German air force has recently been the subject for much argument and speculation. Whether, however, Germany has in fact a separate air force, whether the air force operates under the army or vice versa, the real lesson that we should draw from the German operations in Europe is the extraordinary cooperation which has been exhibited.



otographs Official, U.S. Navy
Hidden above a layer of clouds and catching only occasional glimpse

between air and ground forces, no matter how achieved Destruction wrought by the German air force has been terrible to contemplate it is submitted, however, that such destruction, unco-ordinated with advance of the ground forces, would not have rearranged the map of Europe as we find it today.

It is in this co-ordination between all arms and branches of German national defense that the Luftwaffe has displayed its outstanding qualities and it is in these same characteristics that the U S Navy, including its naval aviation arm, is likewise outstanding For years,

naval aviation has been going to sea with the Fleet, daily, monthly, year in and year out, in each year for at least the last 15, naval aviation has played a large, and many times predominant, part in the annual Fleet maneuvers

Most of the officers and men now serving in naval aviation have served in all its branches battleship- and cruiser-based, patrol plane and carrier squadrons. In their years aboard battleships and cruisers, they have taken their turn at watch-standing and know as well as their comrades on general service duty what the mission of the surface vessel is and how that mission should be carried out. Aboard the carriers they have become thoroughly indoctrinated in the methods of co-ordinating and delivering the group air attack on both enemy surface vessels and aircraft and they realize full well that co-ordination, timing, and teamwork are the essence of any joint effort

In this connection it is of interest to mention that all of the non-flying line officers of the Navy are required to be familiar with the theory and practice of aviation and must periodically, before promotion, undergo examination in this as well as other professional subjects. These non-flying line officers serving in battleships, aircraft carriers, crusers, and tenders are, of course, continually working with the aviation personnel attached to these ships and they in turn learn



Sky-going ships of our aerial Navy. These patrol bombers have wide range and carry enough bombs to start and finish a battle-line Job



of the ground, a utility squadron flies on toward its objective

in this practical way the capabilities and limitations of aviation

Those who serve in the patrol wing understand that, although they carry heavy loads of bombs, their primary mission is to act as the Navy's long-range, high speed air cruisers until the enemy is located and his intentions diagnosed They understand the reason, too, which is that the mission of our Navy in the next war as it has been in the past, will be to seek out and destroy the enemy completely and finally, using all the force at our command on the surface as well as above and below it. The fact that the British were able to evacuate some 300,000 men from Dunkerque to England under the very nose of overwhelming German air powei has not been lost on these men and they want no sole dependence on air power which might allow such a thing, in reverse, to happen on our shores

It is believed to be generally recognized now that one of the greatest and most far-sighted public services which was ever rendered the United States was the determined effort and successful fight waged by the high command of the Navy in preventing the formation. of a unified air service to include naval aviation. We have before us several excellent, if also tragic, examples of the difficulties which the United States might now face had our present course of action not been followed The principal one of these is, of course, that of Brit-

an, wherein the Royal Air Force was set up as a third arm of Britani's defense with the result that the Fleet Air Arm cannot now afford the British Navy the strong air support which that Navy so badly needs. The final history of the present war will record the tragic loss of many British lives because of the silp-ups and misunderstandings inevitable under any such system of divided control

The above record of progress and accomplishment has been set down so that the reader may understand why we in the Navy consider the "bomber versus battleship" ques-

tion an abstract argument. The problem facing the Navy today is to build, upon the excellent nucleus we now have, the expanded naval aviation of tomorrow, maintaining the co-ordination we now possess so that when and if our Navy goes into battle, all its components will be there in adequate number and all will be working together in the most efficient way to achieve the final result—total defeat of the enemy

AIRCRAFT versus Warships

AUTHOUGH Mr. Charles Edison, when Secretary of the Navy some months ago, stated that arriganes have a temporary advantage over battleships, it is apparent that protective measures for the ships were already known. An editorial in a recent issue of The Engineer (London) discusses this matter in detail and states the protection necessary. We quote below a pertinent part of that editorial

"We have now had experience of many months of war, and it is not unreasonable to inquire whether this question can yet be answered. It is, of course, less a single question than a group covered by a single title, for there are ships and ships If we consider first the vitally important question of the battleship, it may be said at once that we do know a great deal more than we did It is true that we knew beforehand that the battleship of today





Torpedo planes, dive bombers, and cruisers—they're all part of the team. Properly co-ordinated, they make a powerful defensive arm

was strongly protected by deck armor and was difficult to hit. To penetrate armor requires high striking velocity, and this, in turn, calls for a high altitude of attack on the part of the aircraft, though the greater this beight the less chance of hitting. Hence the two chair attack requisites were, and still are, mutually conflicting Nor can modern developments materially affect this nesstion.

"The hombs now in use are better streamlined than in the last war and they are heavier, but even so the velocity they acquire during descent remains much where it was Even were air resistance entirely removed, the vertical velocity attained from any height could not exceed that corresponding to a vacuum trajectory, which from 20.-000 feet is but 1100 feet per second; in practice it would, of course, be materially less, and even were the height of release pushed up to 30,-000 feet, or even 40,000 feet, the velocity would be but little greater since, in the neighborhood of the speed of sound, the rapid rise in air resistance cushions further increase Nor could an attack during a dive from high altitude materially alter the situation, since an initial downward speed of even 400 feet per second would hardly affect the velocity at sea level To fire the bomb downward fast enough to increase the ultimate speed would, for a bomb of adequate size, require an aircraft gun of such dimensions and weight as to be outside the field of possibility, whilst any form of rocket-bomb is likely to present great practical difficulties Hence, if the armored deck can keep out a bomb which arrives with a striking velocity of 1100 feet per second, it can be said to have the latter beaten And this, our present war experience has shown it can do

MANE at least of our battleships has been hit by such a bomb and the armored deck has proved to be just that protection which our naval architect said it would be Hence the contest between the battleship and the bomb has largely ceased to be the doubtful factor that it was It is true that this leaves out of account the 'nearmiss,' the bomb which explodes under water close to the ship, but this should be regarded rather as an attack by a mine or aerial torpedo than by a bomb The essence of a bomb is to cause such an explosion inside a ship as will damage the vital machinery below the armored deck, or even hole the ship from the inside; whereas the object of the mine is to blow in the side or bottom of the ship by means of the intense pressure wave created in the water by its detonation. Hence the 'near-miss' must be looked upon as a mining attack and any battleship adequately protected against mine and torpedo may be looked on as protected also against the 'near-miss.''

HELLDIVERS

Describing the Technique of Dive-Bombing. Conceived for United States Naval Use

JAMES L. H. PECK

Ou are at the controls of a rapidly climbing dive-bomber—the most feared, most spectacular of warplanes-miles out over the sea. leading a three-plane "V" formation in search of an enemy cruiser You level off at 8000 feet A moment later, you spot the warship off the port wingtip, you lift the microphone and radio a terse command to your "wing men" The one who is flying behind and to your right, slides over neatly and settles into place behind the left, or Number 2 "wing man." Now the divebombers are in left echelon, or step formation-an excellent arrangement for the attack

You swing in a wide curve to the left: it is early afternoon and you want to keep the formation between the sun and the enemy so that the ship's anti-aircraft gunners will find difficulty in spotting you Peering down at the dark sea to ascertain wind direction to check the drift of smoke from the ship's funnels, you note that the wave crests are rolling in a direction almost parallel to the cruiser's course Good From the angle you are contemplating attack, the wind's effect will tend to compensate for the common tendency to bomb "over." or beyond the craft There will be just one attack; each plane is carrving an 1100-pound armored demolition bomb; each must count.

A succession of staccato explosions just reach you from below when they are duplicated a short distance above, and behind the formation. You make a sharp tack, then another in the opposite direction, then you lead the formation down about 200 feet and make another tack. Shrapnel, accompanied by blossoming, black puffs, burst where the planes were a few seconds ago Almost over the vessel now; you slide to the left just a bit The ship is turning, but it will be just right by the time the bombers drop down.

Another terse radio command.

You roll the speedy monoplane over on its back, "peeling off" the echelon and heading down in one big hurry You are shooting down. a bit over on your back-upside down Now the plane is vertical. vou're streaking down an invisible roller-coaster with the sun at the top The huge engine down shead is throttled back, but not all the way, because the carbureter would flood and the engine would cool off too quickly Down at the bottom you're going to need all the engine you have to get up and away. You have trimmed the bomber's elevator tabs so that the ship is slightly nose-heavy, it dives better so Your eye is glued to the telescope sight, and you watch the cruiser's gray-looking deck and superstructure rush up toward you

HI see grows bluer Guns, turrets, deck gear, and the scrambling crew become larger and more distinct, more detailed. Machine guns swing in the direction of your plane, you are literally flying down the gun barrels. But the sun is with you, protecting you Your left hand darts to the bomb release toggle. You bring the nose up a trifle, just before the toggle is pulled. If the ship were on its back or perfectly vertical at the time of release, the bomb would take a part of the propeller along as it dropped away.

Now! You can feel it as the bomber is freed from its half-ton burden You ease back on the control stick, and ease the throttle open. Ease is definitely the word: You Ease is definitely the word: you built out of the streaking dive in such a manner as to make it.

easy on both the plane and yourself. A weighting force crushes you down against the seat, but there is no blanking-out of vision because the pull-out was gradual. Momentum of the dive, and the power of the engine, boost the dive-bomber up the other side of the invisible roller-coaster at a terrific rate

You look back over the tail at streaking tracers from the vessel's machine guns, but you've much too much speed Your Number 2 man comes out of his dive just above the pall of smoke from your bomb There's a flash and mushroom of evil smoke as his bomb hits the shup's taffrail. Then the Number 3

pilot lets go Just aft of the stern, you see a huge billow of white foam, then a geyser and an expanding ring of churning water Tiny splashes are everywhere, caused by the rain of debris

You throttle down so that the "wing men" can join up. But the formation is just a loose string, a follow-the-leader affair The cruiser lists badly to starboard Your gunner is watching through glasses from the enclosed rear cockpit Men are scurrying about the deck of the cruiser, manning the boats. The ship is going down by the stern, slowly but stendily.

Again you pick up the microphone; but this time your message has to do with saving life, not the taking. You report the success and completion of your mission, and give the sinking vessel's position so that one of your destroyers can pick up the survivors.

That is dive-bombing the method by which more than a few ships have been sent to Davy Jones' Locker during World War II; the method by which Nazi fliers soften land defenses as they form the spearhead of the swarming blitzkrieg assault. This new tactical employment of the dive bomber against airdromes. fortifications and gun emplacements, troop concentrations, supply depots, and other objectives in the British back areas is designed to supplement artillery fire. Hitler's Sturzkampfflug-



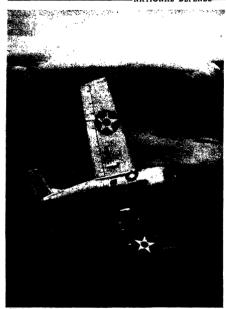
Newest of our dive-bombers is this sensational Northrop XBT-1



Douglas TBD-1's, of Torpedo Squadron Five, "on the way down" in formation

zeug — literally meaning divefighter, and popularly known and feared as "Stuka"—wreaked havoc in Spain, grounded the ill-fated Polish Air Force in just three days, helped make central Norway untenable for the Allies, was a prime factor in bringing about the capitulation of France

ost widely known "Stuka" is the gull-winged Junkers JU-87 monoplane which is powered by a 1000-horsepower Junkers Diesel motor, and has a top speed of 242 miles per hour. The outstanding features of this four-year-old, all-metal, divebomber are its wing flaps and slots and deflector fork. The flaps comprise four hinged surfaces on the wing's trailing edge which may be lowered to increase the air's drag, thereby slowing diving speed from 430 miles per hour to just a few miles per hour more than the ship's top speed in level flight Used in combination with these 'dıvıng brakes" are two slots or foils in the leading edge of the Stuka's wing—all of which make for bombing accuracy, in that the craft can dive within a few hundred feet of the ground to release its deadly cargo The 'Stuka's" deflector fork is the bomb rack gadget which lowers the 1100- or 550-pound bomb so that it will clear the arc of the propeller blades when released The bomb is carried snuggled up against the center section of the wing to diminish air resistance. When the pilot makes ready to dive, the rack is extended Additional firepower consists of four 110-pound bombs carried in wing racks, and three .312 caliber Rheinmettal - Borsig machine guns, two in the wings and one



Grumman mid-wing fighter "pecling off" into a dive. "Pecling off" increases accuracy, as pilot can keep target in sight; when nosing over into a dive, motor and cow! hide target until ship is at a steep angle

for the rear gunner to ward off back-biters

Closely resembling the Junkers plane is the B & V Hamburger 137-an all - metal, single - seater having the same up-swept wing and pointed nose The Henschel 123 is a stubby biplane powered by a radial air-cooled engine, it carries the same armament and bomb load as the more widely known Junkers All three prototypes were originally classified as attack planes or Schlachtflugzeug, and they engage in attack-plane tactics as well as dive bombing The latter are employed against more or less isolated objectives whose destruction calls for extreme accuracy. When strafing enemy troops, however, the attack-plane tactics demand low-flying assaults in which the "Stukas" do not dive steeply, but maneuver on level keel

Machine-gun fire from craft flying at tree-top altitude in horizontal attitude describes a grazing, creeping barrage, while that from planes in a steep dive is necessarily limited in its forward travel The level assault offers more protection, in that hedge-hopping "Stukas" are within sight and range of ground machine-gunners -larger anti-aircraft guns are useless against planes flying lower than 100 feet-for the shortest possible time When diving at a steep angle, they may be seen and fired upon as they are on the way down and, necessarily, on the way up following the pull-out. Low-flying craft are difficult to perceive from higher altitudes, and this offers some protection against enemy pursuit planes "Stukas" operate in three-plane units in both diving and level-flying assaults

Because of the sensational success of both dive and attack tactics in World War II, it would seem that these are new applications But Germany developed an attack plane the armored, all-metal Junkers-Fokker, carrying three machine guns and some 200 pounds of bombs—early in 1917 and the United States conceived the divebomber, primarily for naval use, just ten years later The famous Martin dive-bombers and Curtiss "Helldivers," with their characteristic, back-swept upper wings, became the pride of the Naval Air Service, and the Curtiss 02C's did yeoman service with the Marines in Nicaragua.

ODAY, the all-metal Curtiss SBC-4 biplanes form a very important part of our Flying Fleet. together with the Douglas SB2U and Northrop XBT-1 monoplanes The former two are known as scout-bombers, like their brothers of the Army, the reconnaissance bombers, once they spot the enemy. they stop scouting and commence bombing The Northrop, newest of the Navy's dive craft, is a twoseater and strictly a dive-bomber There can be little doubt that, after the most convincing demonstration abroad, Uncle Sam will provide faster and better dive-bombers aplenty for U. S. defense. The "Helldivers" have come of age

SMOKELESS. FLASHLESS

New U. S. Powders Don't

Betray Gun Positions

A SUPERIOR quality of propellant powder will be manufactured at mew powder plants which are to be built by the government near Louisville, Kentucky, and operated by the du Pont Company. When these plants are ready, the nation's present output will be tripled, these new ones making something like 200,000 pounds per day.

The new powder is not only smokeless but also flashless so that when a gun is fired at night only a dull red glow may be seen a short distance from the gun It is said even the noise will be decreased.

Sikorsky's Helicopter

ALEXANDER KLEMIN

Aviation Editor, Scientific American in charge, Daniel Guggenheim School of Aeronautica, New York University

In our September issue we reported on Igor Sikorsky's views regarding the utility of the helicopter in military operation. With these views we agree thoroughly But the pioneer inventor does not merely hold views, he builds aircraft to substantiate them. Witness the VS-300 helicopter, recently constructed and tested in the plant of Vought-Sikorsky. Aircraft

The new helicopter, as indicated in our photograph, is equipped with a single lifting rotor, threebladed and 28 feet in diameter There is considerable advantage in a single rotor, because the maximum lifting and forward flight efficiency are secured thereby, and because the overall dimensions are kept down to a minimum Moreover, with the engine placed immodustaly below the rotor bub, the transmission system is reduced to its barest elements. With a single lifting airscrew, there is, however a turning moment to take care of, the fuselage and its occupants would otherwise spin around dizzily in space. This difficulty is met by placing a small auxiliary airscrew at the very tail of the helicopter, rotating in a plane which is parallel to the plane of symmetry of the helicopter. With this plane of rotation, the auxiliary airscrew provides lateral thrust and the turning moment of this thrust counteracts the torque of the main rotor When the pitch of this auxiliary airscrew is varied, its thrust is varied. Hence rudder action is provided.

The reader will note that there are two other auxiliary airscrews, mounted on outriggers from the tail end of the main fuseling The pitch of these screws can also be varied at the will of the pitch if their pitch is varied simultaneously they give longitudinal control, that is, control in pitching the craft up or down. If the pitch of the two outboard screws is varied differentially, they give lateral control like the alerons of an airplane

Thus the Sikorsky helicopter has control about all three axes, (which is an essential of all aircraft). Since the controls are engine driven they are operable when the machine is hovering, while ordinary movable control surfaces are operative only when the aircraft has forward velocity.

To secure vertical ascent it is only necessary to give the blades of the main rotor a fairly large positive pitch While the machine



Conventional propeller shank, and shank with ouff (see below)

has not yet risen to very high altitudes, the photograph indicates that ascent has been achieved Forward flight is achieved by simply inclining the machine forward—that is, nose down—using the elevator airscrews for the purpose. Thus the thrust of the main rotor has a forward component which serves to accelerate the machine in a horizontal direction. As a matter of fact, the helicopter can go forward, backward or sidewise

In case of engine failure, the putch of the main rotor will automatically decrease so that vertically decrease so that vertically decrease so that vertically decrease will become possible just as with an autogrin. The auxiliary screws in the same mechanically screws the same mechanical main in the same mechanical main screw whether power is off or on. Therefore the auxiliary screws remain operative as controls even when the engine is dead.

We congratulate Mr Sikorsky on an elegant solution of the helicopter problem, and await further progress with real expectations

PROPELLER CUFFS

ONE of our photographs shows. in its upper left corner, a conventional type of Curtiss Electric Controllable Pitch propeller with the blade shank exposed At the lower right the blade shank is covered by a so-called "cuff" The cuff, of sheet aluminum alloy, continues the airful section of the blade, improves the streamlining and hence the efficiency of the propeller Moreover, the thrust of the propeller is now distributed more closely to its center so that air is driven backward forcibly to the inner portions of the engine Cooling is improved thereby The sheet aluminum cover is easily removed and serviced, and we should not be surprised to see the use of cuffs become widespread -A K



Igor Sikorsky flying his helicopter

Geriatrics

The Newest Medical Specialty Deals with the Aging, Now that the Elderly Increase

BARCLAY MOON NEWMAN

If surprising suddenness, a new division of medicine has appeared—geriatrics—to help old-sters grow older, toward maximum longevity. The name was coined long ago, from ger—indicating old age, and surries meaning therapy But, until a year or two ago, the specialty was little more than name

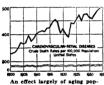
The aged we have always had with us Why this sudden great interest? We have only to look about us—to see more individuals than ever before in the upper age brackets

Greater than ever in world history are the odds in favor of our reaching advanced age. In Rome during the early Christian era, life expectation at birth was probably only 20 to 25 years. In certain European cities of two centuries ago, the newborn could expect to live 25 to 35 years. In the United States, just after the Revolutionary War, the expectation of life at birth was 30 to 35 years, in 1900, 50 years, today, white male babies can look forward to 60 and female to 63 years The increase in expectation of life, at birth, since 1900, slightly surpasses the increase during the previous 100 years. By 1960, a newborn boy of this country may expect to live 75 and a girl 80 years

There has been no observable mcrease, however, in the maximum length of life attainable by the most longevous man or woman Persons surviving to advanced ages do not live longer than formerly. In fact, it is believed that those who, in 1890, reached three score and ten could expect more years than men and women who today are entering their eighth decade.

Only the average duration of life has been increased Thus. in 1890, 72 percent of U S boy babies attained the age of ten, now most than 91 percent do. The early dangerous years are more often survived, and so the average age at death has gone up. Medical discoveries and their wide application. public health measures, improved inturtion, the elevated standard of living, and education, deserve the credit. The chief successes have been over microbic diseases—smallpox, bubonic plaque, yellow, diphtheria, tuberculosis. And newer nutritional discoveries may right now be in the midst of adding another 10 percent to the present average age at death

In the meantime, the birth rate



An effect largely of aging population is the upward trend of the curve: more people live long

cording to some calculations, our population will have become stationary, with the number of births equaling the number of deaths

Declining birth rate and declining mortality rates for infancy, childhood, adolescence, and early adult life co-operate to yield an aging population. A century ago. voungsters under 20 made up half our population. Today only a third of U S individuals are in this group A century ago, less than three percent of the population were elderly, that is, 65 and older. This percentage has already been doubled Within another half century, men and women past 65 will make up more than 15 percent of the total population. More striking, however, is the fact that about 27 percent of us are today already 45 and older. In 1980, more than 40 percent of U S persons-infants to oldsters-will be 45 at the youngest In another ten years (1950), the elderly (those past 64) will be as numerous as children under five years of age—the percentage of each in the total population will be about eight The geriatrician will have as many patients as the pediatrician.

Pensions, old age "economic" schemes, and old age pressure groups have come to the fore, and doctors. like the rest of us, are awakening to the results of the crowding of the higher age brackets. The social and economic results are going to be enormous. Business and its advertisers must take into account the aging of the "average" consumer, who will have different tastes, interests, attitudes, habits, pleasures - and, above all, probably, increased conservatism. The dependent oldster is replacing the dependent voungster

The average doctor notes not only that his average patient is older but also that the number of aged patients has increased Old age is commonly said to begin at 65 However, many individuals are really younger at 75 than the average person is at 55 to 80 Time is a poor indicator of degree of sensespence.

This geriatrician does not find new diseases appearing after a certain age. The elderly have practically all the diseases of youth, but none additional At certain ages, however, certain disorders are more common The so-called degenerative disorders—especially of the circulatory system, the kidneys, and the brain—are less frequent in youth, more frequent in the upper age brackets Sexual decline sets in usually during the middle years, if not before, so is not a problem for the geriatrician alone.

Heart disease takes its greatest toll during the fifth decade, and then declines in relative importance-though still very important as far as genatrics is concerned Arteriosclerosis, found even in babies, is almost universally present in oldsters Chronic high blood pressure becomes more and more common as years are accumulated. The kidneys increasingly are sources of ills as the decades pass. Heart, blood vessels, and kidney pathologies carry off two thirds of those dying between the ages of 80 to 89 Cancer, also found even in babies, is most common in later years For white males, cancer reaches its mortality peak between the ages of 60 and 69, but during the next ten years is almost as important a cause of death. Among women, cancer is most prevalent from 50 to 59, but during the next 20 years the mortality remains high-second only to mortality from heart, blood vessel, kidney diseases. The mortality hazard of tuberculosis attains one peak in the middle twenties, and a second peak in old age. After 60, the tuberculosis death rate rises sharply, the aged having a lower resistance to this disease than the middle-aged.

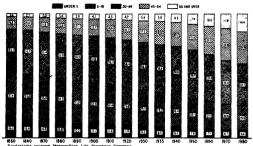
The genatrician, then, must be especially expert along specific lines Furthermore, in advanced age, though there are no new disorders, the same disease usually runs a

course markedly different from that followed in earlier decades. The tissues and organs have changed with time—some say because of time, but nobody can prove this speculation. The reaction of the old body is different, and so are the symptoms and the treatment. Fever typically present in the diseased person of lesser years may often be absent; in lobar pneumonia, the patient may stage a quet, fadeout without fever Appendictits simulates mere intestinal obstruction.

Generally, in the old, there has been loss of weight and height. The fat depots beneath the skin, as of cheeks and temples, are much reduced. The skin itself is, as we all know, markedly altered more pigmented, drier, rougher, wrinkled of course-though the degree of wrinkling is not a good indication of age. The sweat glands and oil glands are wasted. The muscles are deteriorating, perhaps undergoing fatty degeneration. The heart is enlarged, and has deposits of abnormal substances, as do the blood vessels, now much less elastic Lung capacity is much diminished

The bones have become somewhat porous and fragile from loss of calcum and phosphate and from gain of organic matter. There is less cartilage. The spinal curves are accentuated.

Digestive secretions are less in quantity and potency. The stornach, for example, is much less efficient, the gastric juice having a diminished content of hydrochloric acid. The alimentary tract is liable to bulging and the motility of its



ations courtesy Metropolitan Life Insurance Company
What medicine, public health measures, improved nutrition, and better
education are doing to the age composition of our population. 1836-1930
are from census data. 1940-1980, estimated by Thompson and Whelpton

The liver, kidneys, spleen, pancreas and brain are smaller and firmer, and their active cells have been extensively replaced with relatively mert fibrous tissue and fatty or other growths Nerve cells of brain and spinal cord have accumulated mysterious granules, called waste materials by some investigators Tonsils and lymph nodes are extremely shrunken, and the enigmatic thymus gland, too The acid-alkali balance is readily upset and more slowly returns to the normal condition when disturbed, as by toxic substances. The lower extremities are less sensitive to vibrations Sense of balance is impaired In fact, as a general phenomenon, sensation throughout the body is impaired-"the organs suffer in silence," as one geriatrician puts it Even traveling gallstones, excruciatingly painful in more youthful days, may in the elderly pass painlessly down the duct from the gallbladder Youth's elasticity and resilience have sagged

muscular walls seems to be weaker.

Such changes encountered in younger patients would be called pathological. The geriatrician, rightly or wrongly, must now-adays regard them as normal or "physiological". He must not let these common or characteristic changes obscure diagnosis of out-right—more serious or more rapidly acting—disease, for the time being, at least; senescence not being called disease. To recognize disorder in the aged, the geriatrician must first be familiar with the moving picture of that which is termed "orderly

progression of changes incidental to living long" It is difficult to know what is normal or orderly when most of the body is sinking into disorder, practically, the "normal" is the run-of-the-mine, or commonly observed, degeneration The geriatrician's task is all the more confusing when he encounters the stalwarts of 80 or even 90 who are evidentally old but still hale and hearty - with good brains, hearts, livers, and stomachs These stalwarts are either abnormal or supernormal! Their secrets the future may elucidate

Treatment in geriatrics is as specialized and difficult as diagnosis. A severe disease frequently offers only mild symptoms until there is sudden collapse and death Reaction to drugs is greatly altered, they are absorbed slowly, and often faul to give their familiar results Heart stimulants may not stimulate, and sedatives may excitusually do And the drug's effect today may be changed tomorrow Long stays in bed are unsafe, pneumonia or suddenly increased heart weakness makes insidious attacks

On the other hand, the aged body has astonishing powers Contrary surgery better than many young-sters. It is often stated that the wounds of the aged heal slowly Wounds in the adult of any age heal more slowly than wounds in the child After the middle years, there is no percentille restardation.

Diet is important. The vitamins of liver, especially the different vitamins B, have taken on increased importance for the geria-

trician; many of his patients are deficient in these Out of fear of food, many old men and women indulge in harmful food fads Still less fat should be eaten, and me like fattening food avoided The lightweight wins the battle of the century Discoveries on the way may amazingly add to the life expectation after 65.

The geriatrician points out that the psychology of the aged is of immense importance Indeed, physicians are more and more impressed by the theory that the lifelong outlook has major effects on the body The chief cause of early death-before one's actually allotted span is accomplished-is surely the phrase "three score and This phrase, the geriatrician knows, should be replaced by one indicating the real span of life Man possibly is endowed with a life span of more than 100 yearshow much more, even the geriatrician with his rapidly increasing wisdom does not know. But this new specialist, in an apparently discouragingly difficult field, is encouraged to find out-by keeping his patients well, if he can, well past the century mark In the meantime, the basic bio-sciences proceed with the still unavailing search for secrets of requivenation But of requiveration, the geniatrician can take no note, there is today no such thing for man or woman Tomorrow

STEADILY BETTER

Three Decades of Science and Child Mortality

STRIKINGLY presented in the curves of the accompanying figure, from the Statistical Builtain of the Metropolitan Life Insurance Company, are figures which show what the decades of control research health to have done to cramp the style of a variety of prominent disease produced by the style of a variety of prominent disease perms Encouraging are these accomplishments, especially since intensification of the same efforts are expected to continue their improvement

The curves are not based on the general average of the child population but on white children insured in the Metropolitan. The children insured distinctly are not those of a favored class; they are the

children of an urban, wage-earning group who take out small industrial policies—say, \$250—and pay the premiums at the rate of a few cents a week Figures for the general population would, however, not show much variation.

ROTO

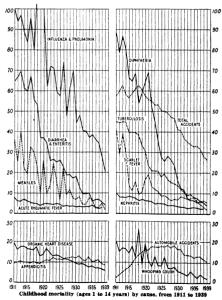
New Cancer Treatment Method By X-Rays

An improved method of using X-rays in the treatment of cancer hidden inside the body has been devised by Dr S J Hawley, Roent-genologist at the Geisinger Memorial Hospital, Danville, Pennsylvania, and is used with modern Westinghouse X-ray apparatus

"In the treatment of cancer hidden deep beneath the skin one of the limitations is the amount of X-rays which the skin can tolerate

during treatment," Dr. Hawley "The X-rays must pass ctates through the skin before penetrating to the cancer, and, since the skin is closer to the X-ray tube, it is subjected to a larger dose than the cancer To get a larger dose into the deeply situated cancer without harming the skin, it has been common practice to aim two, three, four or more beams of X-rays at the cancer through separate areas of the skin This allows a large dose to be given to the cancer while spreading the dose over a large area of the skin '

Dr. Hawley's method is to spread the dose over the largest skin surface while always aiming the beam at the cancer, he places the patient on a turntable and rotates him during the treatment. The patient is positioned on the turntable so that the cancer is centred on the center of the turntable and the X-ray beam is aimed at the cancer.



WE CONSUME—The average American each year requires only 30 pounds of textile fibers and a ton of food, to meet his power demands extile fibers and 10,000 pounds of coal and oil and salvages still more energy from waterfalls, wood, and wind—The Industrial Bulletin of Arthur D. Little, Inc. No. 180

OUR DAILY BREAD.—Three pounds of food and four pounds of water a day will keep the body functioning, but these would be of little use without 34 pounds of air daily .—G R Harrison. "Atoms in Action" page 293

MILES OF R R TRACKS—If all the railroad tracks in the United States were so laid out, they would form 133 parallel tracks between New York City and San Francisco—Association of American Railroads

LEGS GROW MAINLY NEAR KNEES—Contrary to what one might assume, the log bones do not make their logitudinal growth at the same rate throughout their length Most of the growth occurs in the region of the knee joint —The Journal of the American Medical Association, August 10, 1940, page 479

MAN'S BUMP DEFLATED—Recent work by Federal entomologists shows that when mosquitoes have free choice they prefer horses and cattle to human beings by about six to one Pigs were three times as popular as humans Dogs were lightly preferred Man rates just ahead of chickens and cats as a preferred source of the blood meal which most of the biting mosquitoes require before they can begin depositing eggs—Notes, Journal of

SIZE OF RHODE ISLAND—Buildings cover one part in 2500 of the United States area (rough estimate). If brought together they would cover an area about 35 miles square—Popular Astronomy, August 1940, page 369

CIGARETTE SMOKE—A few lighted cugarettes can quickly fill an ordinary room with smoke, but the particle are so tiny that it takes 320 cigarettes—16 packs—to make one ounce of smoke particles—Notes, Westinghouse Electric & Manufacturing Company

STRAIGHT TRACK—A perfectly straight track—78.86 miles in length — on the Seaboard Railway between Wilmington and Hamlet, North Carolina, is the longest stretch of track in the United States without a curve—Association of American Railroads

IMPURE METAL—No metal has ever been made so pure that the spectroscope could not find impurities in it Even the superfine, extra-pure, 1000-proof gold which is the basis of the currencies of many countries is found to contain much atomic durt under this revealing eye which sees through atoms—G R Harrison, "Atoms in Action," page 165

UNLUCKY FRIDAY—The reluctance of seamen to sail on a Friday reached such proportions that many years ago the British government decided to take strong measures in proving the failacy of the superstition They laid the keel of a new vessel on Friday, launched her on a Friday, named her H. M. S. Friday. Then they placed, her in command of a Captain Friday, and sent her to sea on Friday The scheme worked tine, and had only one drawback—neither ship nor crew was ever heard of again —Our Navy, MidAugust 1940, page 15.

POWER DIVE SPEED—A modern plane doing a power dive is moving as fast as a revolver bullet.—G R Harrison, "Atoms in Action," page 319.



50,000 PILOTS—The Civil Aeronautics Authority, charged with responsibility for training 50,000 civilan pilots over the students of the student

LARGEST U S LINER—During her recent sea trials, the S S America exceeded both power and speed requirements, and also bettered her guaranteed fuel consumption figure Designed to develop 34,000 shaft horsepower normally, she averaged 38,000 shaft horsepower during an overload test in the Irials Her contract speed was bettered by over two knots—The Lop, July 1940, page 24

DESERT BUSINESS—Death Valley, commonly thought of as an unmhabitable desert, has its attraction for visitors. It is extimated that visitors spent more than a third of a million dollars in Death Valley during the season of October 1938 to May 1939—Economic Geography, July 1940.

LANDING BY INSTRUMENT—The instrument landing system [for aircraft] at Indianapolis is the most extensive system [for aircraft] at Indianapolis is the most extensive and most complete system installed anywhere in the world. It is an installation providing for instrument approaches and landings in four different directions. All of the 18 stations involved are completely controlled and monitored from the airport control tower—Journal of the Aeronautical Sciences, July 1940, page 383.

ARMAMENTS COST.—During the past five years, expenditures for armaments for the nations were, in American dollars Germany, 19 0 billions, Russia, 13 5 billions, England, 6 2 billions, United States, 51 billions, Japan, 51 billions, France, 49 billions, and Italy 37 billions in Enace, 18 billions, and Italy 37 billions in France, less was obtained per dollar than in the other, low-wage countries—Statistics by Colonel Leonard Ayres, Cleveland Trust Company

RUINATION THAT DID NOT MATERIALIZE—The consumption of marihuana in the United States, which had for several years increased, has recently been effectively checked—Science, August 9, 1940, page 118

PETROLEUM—Underground waste of oil virtually has been eliminated in the development of America's oil reserves. More than 99 5 percent of the recoverable oil known today in underground reservors ultimately will be produced by a continuance of present production methods—Notes, American Petroleum Institute.

ICE CREAM COWS—The total production of more than 1,000,000 cows, supplemented by many tons of fruit and other ingredients, goes to supply the 1,200,000,000 quarts of ice cream which Americans consume annually —Telephone News Bulletin. August 1940.

How Big Does The Moon Look?

In Which it Turns Out that Astronomy Has Something to Learn from Psychology

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carneric Institution of Washington

HERE are some problems, related to astronomy, and perfectly susceptible to investigation by scientific methods, in which training in astronomical observation practically disqualifies one as an investigator

A very pretty instance of this sort was recently reported to the National Academy of Sciences by Professor Boring of the Department of Psychology at Harvard, and later discussed with great interest by a large group of astronomers, old and young, at the Harvard Observatory It deals with the old, every-day question: Why does the Moon look larger when it is low in the sky, near the horizon, than when it is high in the heavens?

Fractically everyone, educated Fractically everyone, educated except and it is practically extractions and it is practically certain that these exceptional folk, being convinced that the Moon does not really look any bigger near the horizon, have trained themselves to disregard the ordinary "evidence of their senses".

This seems a very queer phrase to use; for there is of course no doubt whatever that the true angular diameter of the Moon, when seen near the horizon, is no greater than when it appears in the zenith This is true, no matter whether the diameter, in minutes and seconds of arc, is measured with a sextant, or whether photographs are taken with the same telescope or camera, and is certainly true also of the image of the Moon produced on the retina of the eye by its own lens apparatus

Other things being equal, the Moon actually looks smaller near the horizon; for, at any given instant, it is nearly 4000 miles farther away from an observer who sees it on his horizon than at his zenith, and so appears smaller by 1/60 of its apparent diameter. This effect,

though very easily measurable with instruments, is too small to be perceptible to the unaided eye

The changes in the Moon's angular diameter with its changing distance are much greater, and extend over a range of more than 10 percent These could easily be seen without optical aid, by comparing the Moon on different nights with an artificially illuminated disk of fixed size and distance—say three inches in diameter and 27 feet away-but are not great enough to be detected by comparing what we see one night and what we remember of another. (Should any one wish to try the experiment, the disk should be put at a considerable distance, so that the differences in focus of the eye do not disturb the observations-which. of course, must be made with one eye only.)

The increase of the Moon's apparent size near the horizon is therefore a phenomenon of psychology, and not of physics. The angular diameter is sensibly the same, but the appearance—that is, the conscous perception which follows automatically upon the sense-impression—is very different.

Does our sense of vision then deceive us in this case? Before we answer, we must consider that what we perceive, when we look at an object, or hear a sound, is really an interpretation of our sense-impressions rather than the impressions themselves.

This process of interpretation must start very early indeed in our lives We can none of us remember when we learned that the person who walked across the room toward us was not really growing bigger, but coming nearer. The perception of an individual of fixed size coming nearer displaced that of an enlarging retinal image, long before we had words to express

either. We left the unsophisticated impressions of infancy, and learned to substitute an interpretation based upon more complex experience so thoroughly that we are quite unconscious that we are doing it.

Familiar instances of this kind exhibit the almost universal fact that what seems to us to be the immediate evidence of our sense of the seem of the s

In looking at something at a moderate distance, we have the focussing of the eye on a near object, and the convergence of the two eyes, which gives the stereoscopic effect. Both involve muscular adjustments which, though made without conscious attention, pow-erfully influence our distanceuddments.

Professor Boring and his colleagues—trained psychologists, whose observations of their perceptions were not prejudiced, as are those of astronomers, by too much thinking about how the Moon ought to look-have found that the Moon, even high in the sky, produces the impression of looking as big as a disk 10 or 12 feet away, and of nearly four times its real angular diameter, while near the horizon it looks almost double this size. When the influence of extraneous factors is weakened, as by observing with one eye instead of two, by looking down a long dark tube, and so on, these effects diminish

Another set of external "cues" come from the position of our head and eyes If we look at a low Moon, our heads are normally poised, and our eyes nearly level-that is, with the eyeballs in their normal position To see a high Moon, we must throw our heads back and turn our eyes up That these muscular adjustments have the principal influence upon the "horizon effect" is conclusively shown by the work of the Harvard psychologists When an observer lies flat on his back, and looks up at the sky, so that his head and eyes are in a normal position when he looks straight up, a high Moon looks big to him, and a low Moon, to see which he has to bend his head back. looks smaller. Curiously enough, the same is true of a low Moon in

the direction of his feet, for which he has to bend his head forward, and his eyes down.

Many other ingenious experiments confirm the conclusion that the position of the head and eyes is the principal factor which conditions our perception of how big the Moon looks. The fact that the Moon looks smaller if it appears to be below, as well as above, the observer's personal horizon, at right angles to his backbone, has naturally not been a matter of direct celestial observation.

In the summer of 1918, Dr D. L. Webster-now Professor of Physics at Stanford, then a Captain in the United States Air Service-and the writer were engaged in work on airplane navigation at Langley Field, Virginia. One Sunday afternoon, when no work was being done, we were out on Hampton Roads in a sailboat-incidentally looking at the ships of the Atlantic Fleet, anchored in the Roads Next morning we were flying over the same spot-at perhaps 4000 feetand we noticed independently that the warships, though at the same distance, looked from the air like toys-very much smaller than when seen on the level The impression was so striking that we commented upon it after our return Conversation in the aircraft of that date during flight was hardly possible, so that our impressions were strictly independent. Both were experienced in physical observation and both familiar-one highly so-with things seen from the sea and from the air

The question remains should an object, of the same angular subtense, produce so definite an impression of being largest when it is on or near the horizon? In the writer's opinion, the answer is to be sought in common experiences, involving an interpretation which, though geometrical in nature, is so simple that no formal knowledge of the science is required for it. Consider first, objects below the horizon. We are all used to looking down from a height, a housetop or a tower, hill or mountain. (In these days, one might add an aircraft; but there has not been time for these actual birdseve views to become familiar enough to get into the sub-conscious level)

In the most of such views, we are looking down from a height upon a substantially flat surface—garden, field, or plain. The most rudimentary geometrical sense indicates that an object which ap-

pears at a large angle of depression, far below the horizon, is sion, far below the horizon, is nearer us than one for which this angle is small, and it follows immediately that, of two objects of one the same apparent angular extent, the more distant one must be much the larger We thus soon unconsciously learn to use different scales of real size for bodies of the same angular extent, but different angles of devression.

This is simple enough, but why do we do the same thing for the Moon, in the featureless vault of heaven? The answer, I think, is that the sky is not always featureless. The stainless blue of a perfect day has little about it to make the sky seem nearer in one part than another; but, even then, the paler blue near the horizon suggests haze, and we all associate haziness of appearance with greater distance.

BUT, very often indeed, the sky is clouded, wholly or in part, and more often than not, the clouds form an obviously flat ceiling at a definite (though not obviously measurable) height above the earth. Looking at such a ceiling from below we are geometrically in very closely the same situation as when we look down on a floor from a height. The part of the ceiling directly overhead is the nearest, and the distance of other parts increases steadily with diminishing angular altitude above the horizon An isolated cloud, in a layer of broken clouds like the familiar "mackerel sky" will be smallest for the same angular extent, near the zenith, and larger and larger the nearer it is to the horizon

In the language of the geometer, we project the observed pattern of clouds upon a plane surface at a fixed height above the earth, to get an approximate idea of the real dimensions of its components What we do practically is far simpler than this technical statement would suggest and is "obvious to the meanest intelligence"

It is not clouds alone that call for such subconscious estimates Birds, especially migratory birds, usually fly nearly horizontally, and everyone who knows the country at all must have seen a flock of crows change from mere specks low on the horizon to clearly-seen birds overhead, only to shrink again as they go on their way

These are common observations, which must have been part of human experience since men began to recall and act upon their pasts to recall and act upon their pasts unpressions. It is no wonder that, by this time, we have sub-consciously adopted different scales of real size for bodies high above the horizon and low down Rather may we wonder why the impression that the low Moon looks bigger amounts berely to a doubling in size instead of an increase of five or ten fold

It may be suggested that very . near the horizon flying birds are too remote to be seen, even as specks, and distant clouds are lost in haze. Moreover-as everyone recalls who has seen a sunset at sea under a layer of scattered clouds-the clouds at very low angular altitude do not flatten out into nothingness as perspective on a plane would demand, but remain of finite size right to the horizon They are distributed on a spherical shell concentric with the earthand the sense that clouds right on the horizon are not enormously more distant than those at an altitude of two or three degrees must have arisen long before the true geometry of the case was understood

When we can see the actual horizon, our sub-conscious correction-system is automatically referred to it When we cannot, Professor Boring's researches show that each of us has a personal horizon of his own—referred to his backbone as principal axis—with respect to which the illusion still persists—or, rather, the rational, though unconscious, attempt to make better sense of what we see than mere crude unthinking seeing would do

Further tests of this interpretation are possible. It would be very interesting to find out whether dwellers in mountain-sides, who, from babyhood, were used to seeing objects at large angular elevations and depressions, but at about the same distance, were subject to the "illusion" Observations from aircraft might also tell something. The writer vividly recalls the Moon sweeping from his subjective horizon to the zenith and beyond to the horizon in a few seconds, while the plane in which he was loopedthe-loop at night, and has no recollection that it appeared to change in size But the time of observation was too brief and the conditions otherwise too unusual, to make this recollection of psychological value -Jamestown, Rhode Island July 19, 1940

When You Steer a Motor-Car

Mechanism Has been Designed to Indicate Steering Deviations When Car is Rolling

A. P. PECK

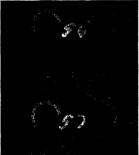
NE of the main objectives of motor-car engineers is to design an automobile that approaches self-sufficiency, that virtually steers itself, that makes less demand on the attention of the driver as far as keeping the car on a straight path is concerned This apparently simple problem involves many parts of the car, as well as such external influences as wind pressure on the car body. The separate actions of the steering gear, of all four wheels, of the chassis itself, contribute to the final result Yet these actions do not take place until the car is in motion, hence they are difficult to record and study

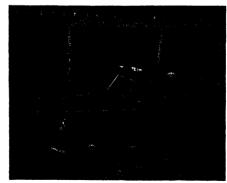
In order to determine the directional adjustment demanded by the modern motor-car—that is, the amount of steering which the driver must do to keep the car on a tue course—and to obtain at the same time accurate data on the actions that necessitate this adjustment, engineers of Pontiac

Motors have designed elaborate equipment that does what was here-tofore considered impossible. It makes records—24 of them a second—of exactly what happens to vital parts of a car when it is in motion over a road. With these records



Below. Set-up of equipment on motor car for recording those factors which contribute to the necessity for directional adjustment. Right: An enlarged frame of movie film taken by the camera on top of the car. Here are recorded the checkerboard background and the four indicating dials. Upper right. The "autosyn" motor, mounted on the front humper, transmits, to its dial, indications of horizontal rear axle movement





available for leisurely study in the laboratories, the engineers are enabled to place their fingers on "reasons why" that might never be found otherwise

The equipment used involves a standard movie camera rigidly mounted on the roof of the car under test, a set of four dials placed on a bracket attached to the front bumper, means for actuating these dials, and a section of Proving Ground track painted in a checkerboard pattern. Available also is a huge airplane propeller with which cross winds of varying velocities can be simulated as desired. Supplementing all this is laboratory mechanism for studying and analyzing the movie film after it is processed

Accompanying photographs show details of the equipment. Attached to the steering wheel and to each of the front wheels are small "autosyn" motors by means of which any

movement of these three units are recorded on three of the four dials to Mounted low on the front bumper recorded on three of the flow is another "autosyn" motor which is coupled through piano wire to the sextensions of the rear axie. This arrangement is so devised as to indi-rangement is so devised as to indi-rangement is of the fourth dial, any tendency of the rear axie to move in a fore-and-art direction

When the test car is placed in motion over the checkerboard track, the movie camera starts to click off 24 frames a second. This camera is so aimed that it photographs simultaneously the four dials as well as that part of the track directly in front of the car. Thus is obtained a continuous record of the motions of the steering gear, of the front wheels, and of the recalls aske, all correlated with the precise



Turntable and checkered disk for studying the movie film records of steering deviations

direction of the car as it travels

After the movie film is developed there comes the laborious and painstaking study of the records and what they indicate In the laboratory is a turntable on which is mounted a disk ruled off into perfect two-inch checkerboard squares The turntable is movable in all directions, its motion being controlled by screws Any displacement of the turntable can be read, on calibrated scales, to degrees. minutes, and seconds A single frame of the movie film is projected on the disk, and the checkerboard image on the film is accurately aligned with the squares on the turntable When this registration is achieved, it is obvious that the disk bears the same relationship to the camera as the camera did to the road when the film was exposed. Thus, by comparison of successive frames of the film it is possible to



Movie projector at left throws film images on turntable at right. By means of accurate adjustments of table, valuable engineering data are obtained

calculate precisely the path of the car and the car's steering abilities. The indications on the four dials show exactly what was happening at any split-second when the car deviated from the straight path. From these data it is possible to eliminate "bugs" in design and to perfect not only steering mechanism but also other car parts that directly influence the steering of the volvels.

The mechanism described was

developed under the direction of Thomas Carmichael, physicist in charge of instrumentation at General Motors Proving Ground, and William H Mamming, assistant chief engineer of Pontiae Says Mr Manning. "The information we have gathered and will continue to obtain by the 'checkerboat dest' makes possible the development of a car whose safety bullt-in characteristics must of necessity supplement the driver's inherent ability."

Carbon Dioxide on Wheels

Industrial Plants and Military Airports Are Using Mobile Units Carrying Fire-Killing Gas

ITH incendialy bombs peppering European airfields and supply depots, military aviation experts are looking to fire-fighting methods which can cope with this growing hazard A leading candidate for the 10b is the carbon dioxide fire-truck, a development that has proved highly successful in tests made by the British Air Ministry as well as our own naval airbase officials. The ability of the CO. to smother oil and gasoline fires quickly makes it doubly valuable at war-zone airfields where a fire serves as a beacon for succeeding waves of bombers if it is not immediately extinguished

Carbon dioxide fire extinguishing is not a brand new development, having been used for some time by oil refineries and other industries where flammable liquids constitute a hazard. But the mounting of high-pressure cylinders, containing large quantities of the gas, on swift fire trucks which can dash around a far-fling airport and extinguish all manner of fires with clouds of the white vapor, is a recent advance. This extinguishing technique has gained support as a result of its successful use by London ARP squads.

Carbon dioxide, which is also used in avaiton and marine installations in the form of small built-in systems for smothering engine compartment fires, functions by diluting the oxygen content of the air around a flame to a point where fire cannot burn This dilution is extremely rapid and the gas penetrates into crevices and past obstructions which might hamper liquid fire-extinguishing agents Carbon dioxide, which becomes a liquid when compressed and turns to gas and snow when released, is to man skin and materials, and recharging of the cylinders is quick and relatively inexpensive. Pressure within the steel storage cylinders is approximately 850 pounds per square inch at 70 degrees. Fahrenheit.

In addition to this main extinguishing agent, most of the new airport trucks are equipped with derricks and grappling hooks which can be thrown over airplanes to pull



them out of range of a fire Ladders, asbestos suits, and gas masks for rescue work are other items of equipment provided for on these trucks, which are usually built on a commercial chassis and have speeds of 50 miles an hour

The gas cylinders are usually stored in banks at the rear of the driver's cab, and are manifolded to hose-reels which give a range of several hundred feet in all directions A supply of charged replacement cylinders is usually kept so that the truck can be used during recharging, which takes but a few hours Some truck models carry water-pumps, while those built for combat zones are usually made as self-sufficient as possible and carry their own supply of water in tanks -for use on hangar fires if hydrants and mains are damaged

Of the trucks so far ordered and hundreds have recently been put into service at British airfields and training schools—few have alogs age acquaities of more than 1500 pounds, although tons of gas can be carried Engineers estimate that 1200 to 1500 pounds of gas is ample to envelop several planes and to enable rescue workers to get to the occupants

To supplement these larger units, or for use on smaller airports or manufacturing properties, a number of trailers and motorcycle units have been developed by the New



Above: Airport fire-fighting truck that carries 1000 pounds of compressed carbon-dioxide gas as well as grappling hooks and a derrick. Left: A motorcycle unit used by the Navy. Right: A small trailer unit carrying 150 pounds of the gas

York engineering firm of Walter Kidde and Company, who have also designed and produced many of the larger trucks. The trailer units, which can be hooked to any handy truck or automobile, or eventrundled to a fire by a couple of men, usually carry upwards of 300 pounds of the carbon-dioxide gas and are equipped with hose-reels and long nozzles to give the unit a wide effective range. The motor-cycle units, several of which have



been purchased by American military fields, carry large quantities of the gas and can accommodate two or three men as they dash around an air-base They also carry portable cylinders of the highly compressed gas which can be lifted off and carried to the seat of a blaze

NYLON

Slow Competition with Silk

Now that the first excitement over the introduction of nylon hosiery has subsided, people are beginning to wonder how deeply nylon will cut into Japanese silk production. Ordinarily the business of producing silk supports two million Japanese farmers and another half million people who reel and handle

Though American production of nylon will be rapidly increased, it is said that the full force of its competition will not be felt by the Japanese silk industry for five to ten years By that time Japan can have readjusted her economy as she did when rayon was first introduced. At that time she turned to production

of the new fiber and is now one of the world's greatest rayon producers She may follow suit with fibers identical or comparable with nylon while silk production will be limited to supplying of a few "luxury" lines.

TURBINE SHAFTS

"Baking" Them

Permanently Straight

A GENERAL ELECTRIC engineer, S. Homer Weaver, recently received a Charles A Coffin award from his company for his method of "bak-nig" permanent straightness into steam turbine shafts and rotors. Turbine rotors weigh up to 10 tons and must retain perfect straightness at 3600 revolutions per minute and 950 degrees, Fahrenheit, operating temperatures.

In Weaver's process, the ma-

chined-straight shaft, or rotor, is suspended in a standard lathe bed The electric oven, sectionalized for different length requirements, is closed about it and controlled heat is applied through strip heaters The rotor is turned at two revolutions per minute, and thermocouples riding on it give temperature readings. As the oven heat is raised, the rotor loses its straightness. Sliding rods pass through the wall and, riding against the turning rotor, indicate increasing shaft deflection as the temperature goes up. Then, at a certain critical temperature, a straightness is restored which is not affected by temperature or temperature changes Thus the treatment is a true stabilizing cure

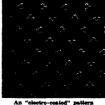
ELECTRO - COATED

High Pile Put on Textiles Electrically

RTIFICIAL lightning," which some years ago was converted into a useful tool for the manufacture of abrasives, is now being harnessed for an apparently unrelated purpose-the production of highpile fabrics that resemble velvet, reports A J. Sidford, writing in a recent issue of The Frontier

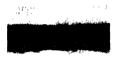
Remote as abrasives and fabrics seem from each other, the principle underlying the use of electrostatic fields is the same in both cases. As early as 1926, Elmer C Schacht produced sandpaper "coated by artificial lightning" at the Watervliet plant of Behr-Manning Corporation This patented process is used to do three things propel, disperse, and orient the particles Since 1932 it has been adopted on a large scale in the manufacture of abrasives. both in this country and abroad

The same process was next applied to the tufting of dress fabrics. and is being employed under ex-



clusive license by Arnold Print Works. Accurately cut particles of cotton, rayon, wool, or mixtures are deposited, under the influence of the electrostatic field, in an upright position on the patterns. which have been previously coated with an adhesive

Then came the latest step in the development-the complete covering of a cotton-backed material with accurately cut fibers. The fibers are securely anchored in a coating of vulcanized latex, producing a high-pile type of fabric that resembles velvet. The electrocoated fabrics are distinguished by depth of pile and density of coat



Enlarged section of Norzon fabric, showing erect fibers

Wear strain is taken on the ends of the fibers, which number as many as 300,000 per square inch, and tests indicate much higher durability than the older type. These new pile fabrics, designated as Norzon. are being tested for upholstery by two leading producers of automohile hodies

Already it is fairly well established that electro-coating can be used for carpets with a very admirable pile surface. That further research may uncover new applications seems entirely probable. A process that has already been adapted to the manufacture of abrasives and textiles undoubtedly has other uses as yet undiscovered

MIRRORS

Made By Automatic Process

A TOUGH film of silver of unprecedented hardness is achieved in an almost wholly automatic process of mirror making developed by Logan Porter Mirror Company The manufacturers claim that the silver solution is scientifically proportioned to every square inch of glass to be covered.

In this new process, glass plates are placed on a conveyor outside the processing, rooms. Here they are flushed of all surface impuri-



Mirror production line

ties preparatory to a gentle, thorough scrubbing with distilled water inside the machines. The sensitizing fluid flows from the laboratory above to each plate in an exactly adjusted quantity and the continuously operating conveyor carries the plate to the automatic silvering device. The mirrors meet human contact only after the processing when the conveyor carries them outside the processing room to be stacked manually

CRANBERRY CHEMICALS

RANBERRIES, graduated from the laboratory recently, came out with a product worth \$80 an ounce! Chemists call it "ursolic acid." Cranberry growers call it a lucky break This hitherto rare, emulsifying agent which helps to make oil and water mix, is derived from the skins discarded in the manufacture of cranberry sauce. From the same "waste" product, cranberry seed oil, a rich source of vitamin A. can be obtained. Plans are afoot for a \$50,000 "pilot plant" to pioneer the manufacture of the two new products.

CONTROL MECHANISM

Device Stops a Machine Error Before it Happens

A DEVICE which operates on the principle of acceleration rather than velocity and is sensitive to the rate at which a change is taking place rather than the extent to which the change has progressed has been developed in the Westinghouse Research Laboratories It actually begins to correct something that has started to happen before it can happen This is a new high-speed regulator which, in combination with a novel gyroscopic stability control, indicates the possibility of some promising applications for the control of motions and speeds in many mechanical operations and processes

"Experiments now in progress," reports M. W. Smith, wee president of Westinghouse, "indicate the possibility of using this scheme for the control of tension and gage thickness of steel produced on high-speed strip mills if this experiment is successful, it will materially reduce the scrap losses from off-gage material, which is one of the major problems in the steel industry today."

CLOTH TESTER

Machine Wears Surface

Developed for industrial use in determining abrasion resistance of plated metals, for example, the Taber Abraser has been adapted to testing of woven fabrics. This adaptation is based on the continuous rotary principle, though the pressures against the specimen are considerably smaller than those employed in the larger abraser for use on paint surfaces.

In the rotating head, a piece of the fabric to be tested is clamped tightly by the special ring that is employed for this purpose. The



Above: Compact cloth tester in use. Below: Typical cloth sections after test, showing how surface is worn by the Abraser



motor then rotates the head at a speed of 60 to 70 revolutions per minute and the test is continued until the two abrasive wheels have worn the fabric to an approciable degree Comparison between different kinds of cloth may easily be made by running each for the same period of time under the wheels of the abraser; the wearing quality of each may be determined under test with strict controls

TACHOMETER

Needs No Contact with Rotating Part

OFTEN it is desirable to check the speed of rotating or vibrating parts when it is impossible to get at those



When determining the speed of rotating parts with a new tachometer, it is only necessary to hold the tachometer case in contact with machine housing

parts with an ordinary tachometer Such is the case, for example, with electric refrigerators, vacuum cleaners, electric shavers, concrete vibrators, and similar equipment James G Biddle Company has developed an instrument which overcomes this difficulty. The new instrument, called the Frahm Hand Tachometer, is of the vibrating reed type and needs merely to be held against some part of the machine whose rotational or vibrational speed it is desired to learn In the accompanying photograph it is shown taking the speed of a vacuum cleaner.

The principle of this device is as simple as a tuning fork. The sole mechanism is a set of very accurately tuned steel reeds On the principle of resonance, certain of

these reeds become energized by the vibration of the machine on which the instrument is held or mounted. The speed of the machine is then read on the scale of the instrument

The advantages of this device are that it requires no contact with the rotating element, imposes no load on even the smallest motor, can be used in any position, does not have to be oiled, and has no wearing parts, no magnets, or electrical connections.

GAS ATMOSPHERES

Indicator Keeps Constant Watch on Explosive Mixtures

In industries where hazardous mixtures of air and gases of any kind occur, it has been common practice to draw a sample of the mixture irto a container which is then carried to a laboratory for analysis On the results of such a test, certain manufacturing common tools or changes in operation may be made In this process there is not only a delay but also the possibility that the sample of the mixture may become contaminated.

An analyzing unit called the Davis Continuous Combustible Gas Indicator prevents all such errors because its analyzing head is installed immediately in the area to be tested. This indicator consists of one or more analyzing heads, a panel box, and a pump. The sample



Panel box and analyzing head of new combustible gas alarm

of gas and air mixture is drawn through only a few inches of tubing and the determination of the mixture's characteristics is instantaneous Each analyzing cell, of which there may be a number installed at various locations, forms a part of a complete Wheatstone bridge circuit, the other half of the circuit being located in the panel box which is the indicating part of the system.



CEMENTED CARBIDES

The first World War saw the introduction of a maternal in Germany which has become an indispensable and to domestic production in the present holocaust. This maternal is cemented carbide (See Scientific American, February, 1935) Introduced to this country in the late twenties, the technique of manufacturing it to desired forms as well as the knowledge of how to use it in industry has improved by leaps and bounds. Now the pressure of war preparation has brought it into full flower.

Tools typed with cemented carbides have permitted acceleration of metal cutting operations a hundred fold, and progressive manufacturers were fairly prompt to adopt them. Now, even the backward producer must employ cemented carbides or fall behind because defense preparation gaing in Likewise, the marginal producer climbs aboard because it's necessity, not choose, which governs use

MACHINE TOOLS

You have heard lots about the shortage of machine tools and the high rate of obsolescence, but you rarely hear of the part the cemented carbides have played in bringing about this situation Machine tools wear out, but cemented carbides made them obsolete. Old-style machine tools would not permit maximum use of cemented carbide tools. They couldn't stand the punishment inflicted by the high operating speeds, hence much of the machine-tool replacement of recent years has been done to bring equipment into line with modern practice. Fortunately for industry, machine-tool builders re-designed their product long before the present emergency.

Incidentially, the centers of machine-tool manufacture are humming day and night A superficial survey of plant expansion made the other day revealed that more than 300,000 square feet of new manufacturing space is about to go into use

CIGARETTE PAPER

It seems most likely that laymen will feel the annoyance of war in small, incidental ways—at least for some time to come. Apropos of this I anticipated trouble to the cigarette manufacturers due to the shutting off of paper from French mills. But it develops that American mill capacity can be expanded to meet all needs and that there is plenty of flax grown in the United States to make all the paper we can use. We already have a small production and a new company got into operation about a year ago. Thus tragedy becomes an opportunity.

SHEET-WIRE

No industrial process is free from the possibility of revolutionary change, looking to lower costs and better quality. Among the recent upsets, for which there is promise, is a wire-producing process which ignores the customary multiple drawing operations. Here's how it works:

The first step is to butt-weld strip to permit continu-

ous operation. The strip is then grooved longitudinally between forming rolls. Next step is to pass the grooved strip over vertically staggered slitting rolls to separate the strands. At this stage an eight-sided wire emerges. The finish operation, conducted in two stages, puts the strands through trimming dies to give the wire 16 sides (cross-section), but if wholly round wire is desired, a bass through a semi-drawing die does it.

It should be noted that annealing and pickling operations are climinated by this process as well as the use of multiple drawing dies. Sponsors of the process are going to apply it to the manufacture of wire red and hex bar direct from sheet bar, with the promise of, cost saving.

POWDERED IBON

A plant for the production of powdered iron has been projected for the West Coast, now that imports from Sweden are no more. This news is significant for two reasons. It represents a capitalizing on world trade dislocation to the benefit of domestic industry, it is proof of growing commercial importance of metal nowders.

Powder metallurgy evolved from the need to handle metals too refractory to be melted or cast convenently First application was in production of tungsten filament (See February, 1939) It also permitted the combining of components which would not alloy properly because of extreme differences in melting points or because of immiscibility. Since then a host of applications have been developed

What will be attempted in California is the gasreduction of iron ore—novel in itself—with the stated benefit of obtaining a high purity product and accurately controlled carbon content due to the low temperature employed, which reduces the iron without a coincidental reduction of the oxides. Also claimed by the sponsors is the opportunity to utilize large deposits of iron ore hitherto blocked by the lack of coking coal. Large-scale use: of powdered iron is the automobile industry, finding that many small parts can be made cheaper and better by compressing and sintening powders to exact form

SELF-SUFFICIENCY

Whatever our capacity to meet the exigencies of trade stoppage, whatever our ingenuity a substitution, time is the all-important factor in reaching selfsufficiency. For this reason, every move made right now may be worth a hundred frantic moves made later Here, then, is progress to provide a cheery note

Anaconda Copper Mining Company announces the breaking of ground for a smelter, capable of producing 100,000 tons of manganese annually, starting six to nine months from now Manganese is an essential in steel production, which puts it at the top or near top as a strategic material. A new process for extraction from low grade ores makes this project feasible

American Cyanamid Company, looking to the time when artificial rubber will swing into big production, is undertaking large scale manufacture of acrylic nitrile, one of the essential components of Perbunan

Koppers Company announces building of a plant for the production of ammonium thiocyanate crystants, hitherto imported This chemical, recovered from manufactured gas, is a base for many resins, application in the textile, chemical, and metallurgical industries.

- Philip H. Smith

The Evanescent Mesotron

With Knowledge Incomplete, Science Strives to Account for some Puzzling Phenomena

C. W. SHEPPARD

O NE day in 1937 physicists studying the cosmic rays discovered another new sub-atomic particle. This new physical specimen they named the mesotron, sometimes meson It was about 180 times as heavy as an electron and carried the same charge.

Almost at once, a few of the Olympian souls who breathe the rarefied air of theoretical physics announced that this new particle would turn out to be one of the most important discoveries of the decade. There are two reasons why they believe this to be true. Let us consider the first.

As most persons know the atoms out of which matter is constructed are tiny "solar systems" Each has a central nucleus and a number of electrons revolving around it, like planets around the Sun many years of hard work, scientists have managed to push their explorations inside this outer group of electrons and actually find out what the tiny nucleus is made of. They will now tell you that it is a collection of two kinds of particles -neutrons and protons These particles weigh almost the sameabout 1800 times the mass of an electron The proton carries a single electric charge, the neutron does not One can picture the average nucleus as a collection of protons and a slightly larger number of neutrons They cling together like a sort of popcorn ball, each one touching the next, and they perform an irregular spinning, vibrating, and churning motion around each other

But all was not plan sailing. The thing which had to be explained was the nature of these sticking forces which caused the nucleus to be held together so powerfully against the natural electrical repulsion of the positively, and, therefore, like-charged, protons This glue-like force behaves in such a strange manner that it cannot be an electrical or a gravita-

tional attraction but must be something new Electrical and gravitational forces act in a characteristic manner, they exert their influence over a large distance. For example, in the case of the attraction of the planets of the solar system, the gravitational force of the Sun acts with great strength over a distance of many thousands of times the size of the Sun itself Nuclear forces, however, are entirely different. If one could get in and pry out one of the particles, he would find that this took a tremendous effort, but, once he got the particle out a little way, it would snap free and the force would drop off sharply Furthermore, the force is such that any particle in the nucleus is acted on by only a few other particles nearby, while the rest of the nucleus has no effect These peculiarities of nuclear forces have convinced scientists that they are here dealing with a brand new force hitherto unknown to physics

HEORETICAL physicists sharpened Theoretical physical their pencils and went to work on the problem of these forces It soon became evident from theory that the force which a neutron and proton exerted on one another could be explained only if the two particles were constantly exchanging places This may seem a strange idea, but to the physicist it was no more strange than many other recent ideas about physical forces To explain it, consider for a moment the electrical force between two electric charges. How can one charge act on another which may be a long distance away? How can it cause that distant charge to move and how can it 1mpart momentum and energy to it? One modern explanation says that the one charge gives out electrical disturbances, or "protons," such as constitute light and other socalled "ether vibrations," and that these electromagnetic corpuscles are absorbed by the other charge and act as energy and momentum conveyors between the charges

In 1935, this idea suggested to

the Japanese physicist, Yukawa, that nuclear forces also possessed "carriers." But, unlike electrical forces, the nuclear forces require the proton and neutron to change places, as stated before. Yukawa explained this by saying that, in this case, the carrier was a charged particle If it were positively charged it could leave a proton, changing it to a neutron; and arriving at a neutron, it would change it to a proton (Figure 1, left). If the carrier particle were negative, it would do the opposite (Figure 1, right). This assumption of a continual stream of carriers going back and forth between protons and neutrons would account for the interchange forces. By a simple calculation, Yukawa was at once able to show that this carrier would weigh about 180 times as much as an electron

After the discovery of the mesotron, two years later, it took theoretical physicists very little time to



Figure 1: Exchange of proton and neutron in atomic nucleus. Left: For a positive mesotron. Right: Same for a negative one

agree that this was Yukawa's carrier particle. An apparently crazy theory had carried with it a prediction which came true!

The new particle soon showed itself to be important for a second reason There are certain radio-active substances, either in nature or artificially made in the laboratory by nuclear transmutations, which eject electrons, either positive or negative. It is known that, when a nucleus shoots such a particle out, a certain definite amount of energy is let loose. Unfortunately, however, if one examines the electron after it is emitted, one finds that it usually doesn't have the correct amount of energy, but a good deal less Scientists therefore have been forced to say that the missing part of the energy has been carried away by a phantom particle which has no charge and practically no mass-the one marked ? in Figure 2. This particle has been named the neutrino, but it has never ac-

All this is bad enough, but let us consider for a moment: We have said that the nucleus consists of protons, neutrons, and carrier mesotrons alone If this is true, where do the ejected electron and neutrino come from? The suggestion soon was made that the mesotron is not a stable particle but that it disintegrates into an electron and a neutrino Its extra mass would then he converted into energy in accordance with the theory of relativity, and carried away by the neutrino. Calculations showed that on this assumption the mesotron could last only a few millionths of a second before this decay process occurred

It was at once evident that, if mesotrons decayed in this manner, it should be possible to detect the



Figure 2. New explanation of the radio-active emission of electrons from an atomic nucleus. In case I, at left, the electron emitted is positive and in Case II, at the right, it is negative

decay in the mesotrons present in the cosmic rays A mesotron should, in such a case, decay in its rapid course within several hundred feet of where it was produced To test this assumption, Professor Bruno Rossi, of the University of Chicago, hauled a truckload of apparatus to the top of Mount Evans in Colorado At an altitude of 24 miles, he measured the intensity of the cosmic ray mesotrons found there. He then descended to Echo Lake, about 4 of a mile lower, and repeated the experiment. He compared the loss of mesotrons in the intervening §-mile air blanket with the loss in traversing a block of carbon of the same absorbing power and found that less than half as many got through the air as through the carbon. The conclusion was that, in 4 of a mile travel, many mesotrons had had time to decay.

To settle the matter once and fof all, scientists turned to the Wilson Chamber. This remarkable instrument works in the following manner: An enclosed glass chamber contains a small amount of water or alcohol. This evaporates, filling the vessel with saturated vapor. A

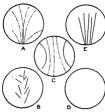


Figure 3: How the five fundamental particles involved in modern theories of the atomic nucleus appear in the Wilson chamber.

- A: Electrons make weak, straggling tracks which can be curved by application of a magnetic field perpendicular to the page. Positive electrons bend one way, negative the other.
- B. Neutrons are not charged and thus cannot lonize the vapor in the chamber and leave a track. However, they are heavy enough to collide with protons, which then produce so-called recoil tracks having this characteristic appearance.
- C: Mesotrons are hard to identify. When going fast they look like electrons; when going slow, like protons, though they curve more in a magnetic field.
- D: The neutrino makes no track and is not heavy enough to make recoils, and thus cannot be seen.
- E: Protons have a distinct and fairly heavy track which is practically straight except in fairly strong magnetic fields.

piston in the bottom is suddenly drawn out This causes expansion, thus lowering the temperature enough to make the vapor condense The expansion is adjusted carefully until condensation just fails to occur If now any small, charged particle, such as an electron or proton, goes through the chamber, its electrical action causes the molecules of vapor in its path to become 10nized These ions now act as centers of condensation which cause tiny droplets to form, and the result is a track which can be seen and also photographed.

Such an instrument was the ideal thing for detecting the decay of a mesotron, but it had one failing It is only when a mesotron is going slowly near the end of its travel that its track can be distinguished from that of an electron. Thus, to

the relatively rare occurrence of decay was added the further rarity of decay near the end of its course For this reason, many pictures had to be taken to catch such a rare phenomenon in the act of taking place

Early in 1939, the English physicist, E. J. Williams, had set out to catch a mesotron in the act of decaying. Within a few months his patience was rewarded, and he got a picture of the heavy track of a mesotron suddenly coming to an end in the chamber (Figure 3, C). From the end of this track came the very faint track of an electron, as called for in Figure 2. Since the neutrino, the other particle called for in Figure 2, has no charge, it produces no track and thus could

All the foregoing work has shown that the mesotron is just about what physicists have been crying for It casts new light on the nature of nuclear forces, explains the emission of electrons from radioactive nuclei, and strengthens one's belief in the existence of that phantom particle, the neutrino

But there still are a few unanswered questions. It is known that forces between neutrons and neutrons, and between protons and protons, are almost as strong as those between protons and neu-This indicates that there trone must be neutral mesotrons as well as the charged ones already discov... Certain meager evidence ered which has been brought forward to prove the existence of such particles has been felt to be entirely inconclusive

Why are mesotrons not found in the laboratory? It is known that it takes about 100,000,000 volts to takes about 100,000,000 volts to make a free mesotron. The only place where such energies now exsists in the cosmic rays A thresent, attempts are being made at the University of California to produce such high energies with the large evelotron

SPECTRO - PHOTOMETER

Analyzes Alloys By their Light In Less Than Two Minutes

An automatic machine which rapidly and accurately analyzes various materials, an invention expected to prove of tremendous value in accelerating the inspection of metals and alloys in the na-

tion's defense program, has been developed by Prof George R Harrison and his associates at the Massachusetts Institute of Technology, reports Science Service.

The device, known as an automatic high-speed recording spectro-photometer, not only analyzes materials, as does the spectroscope, but quickly draws the graphs and curves depicting the results of its analysis. It completes the entire process for a given sample in about 100 seconds—less than two minities.

Heretofore, scientists have used a spectrograph to analyze the material but they have then been forced to interpret this analysis on other machines, a procedure which often required half a day or more. The new device makes records and interprets 20 measurements a second, doing so with an accuracy of one part in a hundred.

one part in a number The device covers a broad spectral range, making its investigations not only in the visible range of the spectrum but also in the infra-red and ultra-violet regions It is fairly simple in its operation and, according to Dr Harrison, could easily be adapted to other similar problems

HYGROMETER

Electrical Device for Measuring Humidity at High Altitudes

A NEW type of electric hygrometer has recently been developed by Francis W Dunmore, of the Radio Section of the National Bureau of Standards It has proved superior to other types for measuring upper-air humidities by the radiosonde, because of its rapid response and ability to function at low temperatures It may also be used for making and recording humidity readings when the humidity unit is remote from the point of indication As it is comparatively small it may be used for measuring humidities in confined spaces

The device, which gives results accurate to within 2 or 3 percent consists of two fine palladium wires spirally wound about 1/64 indepart, 20 turns per inch, on a thin-walled aluminum tube which has a thin insulating coating of water-resistant polystyrene resin. The wound unit is then covered with a very thin film of partially hydro-lyzed polyvinyl acetate with the addition of a small amount of thinum childred. The latter takes

up water very rapidly. With such a device the electrical resistance of the film between the two spiral coils is dependent upon the humidity of the air in contact with the film. The variations in resistance



For measuring humidity

may change the audio note which the radio-sonde transmits of may be made to operate a direct-reading ohmeter with the resistance scale marked in terms of percentage of relative humidity

MORAL SCIENCE Physical Science Becomes Dangerous if Dishonest

The scientist is more honest in his work than is the politician because lack of morality in science is likely to destroy the experimenter, says of Harlow Shapley, director of the Harvard College Observatory, according to Science Service It is perversion of international morality, he believes, not of gadgetry, that has resulted in the decay of present-day society

"Morality in physics and chemistry is to some extent forced," he said "The scientist, naturally, is as human in his irrationality as others Survival, however, requires a kind of honesty. The unmoral experimenter poisons himself or blows himself up.

"If only a false economic doctrine, while still prenatal, would also electrocute its progenitor! Or an education schism backfire during fabrication and reduce its advocate to impotent illiteracy and confusions!"

A closer communion between the physical, psychological, and social sciences was urged by Dr. Shapley as a means toward development, for the social and psychological sciences, of "a logical and rigorously experimental method similar to that which has brought such achievement in the physical sciences."

"The value of these methods," he said. "are well-publicized by the success of everyday tools. You rely on your electrical refrigerator, designed by the engineers; but you

trust mighty little your politicians and diplomats. Thousands of people ride in automobiles with complete confidence in their mechanism. They worry not at all about the engine; reserving their anxiety for the unvenfied assertions of their Congressman, for the economic system, for the treachery of man in fields where a forced morality does not exist.

"If we are to escape descent into darkness," he declared, "the scientist must join forces with other intellectual leaders, because on the advances in the educational, social, and political fields, does the advance of our science depend"

CATTLE PATERNITY

BLOOD tests can be used to settle paternity questions among cattle. Dr Lloyd C Ferguson, of the University of Wisconsin, recently reported Procedure, however, is not the same as in human cases. Human paternity is decided on the basis of blood types, such as are used in matching" blood for transfusions In cattle, the things used are antigens-definite chemical entities in the blood that react in the presence of one particular substance. Cattle. blood has been shown to possess something over 20 such antigens. each dependent on a single hereditary character or gene

WEATHER

Automatic Radio Weather

Reporter Aids Study

AUTOMATIC weather observing stations, untouched by human hands for months at a time, may soon be scattered around on high mountain peaks or at inaccessible sea locations so that Unice Sam's weathermen can have complete and automatic radio reports on the changing weather, necessary for predictions, saws Science Service.

An automatic radio weather reporter, developed by two National Bureau of Standards radio engineers, Harry Diamond and Willow S Hinman, Jr, with the co-operation of the Naval Bureau of Aeronautics, has undergone a successful two-months test at Naval Air Station at Anacostia

Radio messages that it sends out at predetermined intervals tell the barometric pressure, air temperature, relative humidity, wind direction and velocity, rainfall, and other meteorological factors.

Roots are Pumps

Research Shows Capillary Attraction Has Little To Do With Sap Circulation

PHILIP H. SMITH

Tomato roots, no bigger than a piece of store twine, have a pumping mechanism capable of developing pressures of 90 pounds per square inch.

This is one of the recent findings of science and it may help to explain the phenomenon of sap rise which has puzzled scientists for centuries

If and when you studied botany, your professor probably gave you the "cohesion" theory to explain the movement of fluid in plants and trees This theory recognizes the enormous pull generated by evaporation at leaf surfaces and the fact that water has great tensile strength in capillary tubes. It seemed to be the best theory available and even now it isn't voided by the revelation of root-pressure, but it falls short of explaining the sudden uprush of sap when there are no leaves to transpire, or how fluid can be lifted as high as 350 feet, as it must in the tallest trees

The reality of root-pressure was confirmed at the Rockefeller Institute for Medical Research as a sort of scientific by-product Dr Philip White, of the Department of Animal and Plant Pathology, was trying to find out how viruses are carried around in a plant which has no circulatory system such as 1s found in man He turned to the vitalistic root-pressure theory which had been advanced about 200 years ago by the Englishman, Stephen Hales, the extraordinary clergyman who first measured blood-pressure in animals, and invented the first gas mask and the first ventilating system for ships Hales' theory had been abandoned in favor of more mechanistic theories. He had worked with decapitated, dving roots and the slight pressure obtained was unconvincing.

To carry out his experiments, Dr. White built upon a previous achievement—that of being able to keep excised roots alive in nutrient. Roots can be made to live indefin-

itely, floating in a beaker, provided they are supplied with everything they get normally from soil plus what they would get from the air if they had the benefit of leaves a sort of super-hydroponics

Just such a delicate root strand. kept alive for several years under artificial conditions, was selected for the experiment. Its base was inserted in a glass tube, or capillary manometer, and anchored firmly in place with a rubber collar, to give a set-up in which part of the root was in the tube and part protruding into the nutrient. The root then secreted water into the tube, building up pressure When the pressure mounted it became necessary to add a metal clamp lest the rubber be runtured, but at no time could the root itself be crushed

When first attempted, the surprising pressure lifted the water to a height necessitating the running of the tube up a starway to a second floor, and even that wasn't enough. When mercury was subsituated for water in the tube, the pumping was mantained with irresistable force. Finally, to keep the experiment within bounds, compressed air was applied at the opposite end of the tube and the root forced to pump against it, which it did readily

It was observed, also, that whether pumping against pressure or not, the rate of secretion displayed a diurnal rhythm.

Ninety pounds pressure repre-



Manometer assembly used in the study of plant root pressures



Root pressure apparatus show-

sents the limit reached by experiments rather than the limit of root capacity. When 90 pounds was attained, the root was still pumping, and Dr. White is of the opinion that pressure cannot be less than 150 pounds per square inch, and is probably more.

One now wonders what starts the rise of sap in the spring Observing nature, one would guess temperature or light, or both acting together However, subsequent experiments, conducted elsewhere. under controlled conditions of temperature and light, failed either to stop or start the numping, or to alter the diurnal rhythm Nature holds her secret close. One might wonder, too, what difference there is in the constituents of the nutrient taken in by the root and the fluid secreted by it Are the nutritional elements removed, or are some food values passed along to nourish the rest of the plant which isn't there? The quantities available for analysis are so minute that special methods will have to be devised for such determination

Scientists do have an interest in trying to determine whether there is a diurnal rhythm in respiration rate corresponding to the rhythm of secretion. If this could be established, it might reveal the mechanism which supplies the energy for the pumming.

The nature of this work warrants the layman's critical "So what?" Are there immediate, practical results? The reply must be "No." We are simply further along in the understanding of plant physiology Add other facts yet unknown, to widen the horizon, and sometime the practical value may emerge in the most unforeseen manner as it has in injumerable cases.

Business and Changing Climates

Are Slow Climatic Changes the Basic, Underlying Cause of Economic Cycles?

CLARENCE A. MILLS, M.D., Ph.D.

Man is far from a uniform being of standard proportions and capacity for accomplishment—he differs widely from place to place and from time to time Years of investigation have revealed that the primary basis of these variations is the ease or difficulty of heat loss from the body.

All bodily and mental activities or functions are intimately bound up with the combustion of foodstuffs in the cells and the liberation of heat and energy Every activity in the body is accompanied by and dependent on this combustion and heat production. Growth and development, ability to resist infections, as well as muscular and mental activity, are based on this internal burning of food materials Hence the factors that determine the combustion rate become dommant forces controlling the general activity and energy level of the individual

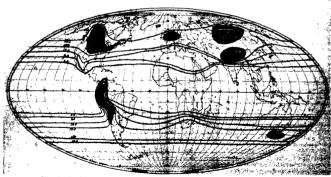
With man-and other warm-

blooded animals-the body temperature is maintained at a constant level, usually above that of the surrounding environment So long as life processes go on, heat must be dissipated to the surroundings, else fever and death ensue Higher external temperatures, making heat loss more difficult, result in a suppression of internal combustion and a lowered level of vitality and general body function Growth and rate of development are slowed, resistance to infection falls, and energy available for action is sharply curtailed When body heat loss is accelerated by lower outside temperatures, just the reverse occurs. It is in the temperate regions of the earth, where body heat can easily be dissipated, that children are heaviest at birth. grow most rapidly, enter puberty earliest, and reach greatest adult size There energy available for action is highest and people are irresistibly driven into a restless activity that attacks difficult problems with a high degree of success.

In polar cold, however, body heat loss becomes too free, and, instead of human vitality and energy there rising highest, it tends to fast as the body is faced with the necessity of using too much of its combustion activity merely for keeping warm. The exhaustion effect of prolonged cold is seen also in the temperate regions during late winer, when the death and sickness rates rise, and all other indices of general vitality fall.

Man, then, responds very definitely in a great varety of ways to the ease with which he loses his body heat The temperate regions of the earth are in general best adapted for his maximum activity, tropical warmth subdues his functions, while polar cold exhausts and benumbs This is relatively new concept of the dynamics of human existence and of the part climate and rate of body heat loss play in life. Let us now see just what this concept means for mankind over the earth.

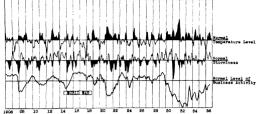
THE tropical lethargy and listlessness, carefree existence, together with retarded growth rate and body development, result directly from the difficulty people there experience in getting rid of the heat production that goes with a higher level of bodily activity. In the coolness of the temperate zone existence is on a faster, more energetic plane. While infections account for most of the deaths among



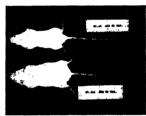
Climatic stimulation over the earth. Index numbers represent intensity of the climatic drive

tropical natives of low vitality, in the energizing temperate climates it is body breakdown from the strain of a fast pace of life that kills the greatest number Vascular sclerosis, heart failure, diabetes, pernicious anemia, nervous and mental breakdown -these are the signs of stress that are mounting as causes of disability and death in the regions of most energizing cli-

It has ever been the people of cooler lands who have ruled over and



Weather stimulation and business activity (industrial area of the United States).
Upper curve: Deviations from normal temperature. Middle: Deviations from normal storminess or temperature variation. Bottom: The fluctuations of business activity.



Environmental temperatures and body growth. Smaller mouse represents average size of a large group raised in tropical moist heat (artificial), while those raised under identical conditions except in a cold atmosphere are represented by the lower one of large, robust form. But the ones raised in warmth live longer, though less actived

exploited the less fortunate ones living under depressing, moist warmth In wars between nations the same energy gradient has also been a determining factor in the final outcome, for rarely can a lowenergy people withstand armed forces full of vigor and determina-

Regional differences in energy level have been of untold importance throughout the course of history, but there have also existed differences on a time base that have altered the destmy of individuals and whole population masses. The most common time change in energy level is the one that man undergoes as the seasons of each year pass. Energy in temperate regions rises highest through the fall and winter months and subdicts to its lowest level in summer heat. Man actually usee less oxygen and has a

lower blood pressure in summer heat than he has in winter cold

Unexpected and unpredicted changes in this climate stimulation, however, bring disastrous uspests in human plans, and with these irregular changes in earth temperatures go changes in human energy level and desire or ability to accomplish

Correlation of such temperature changes with business activity, back through the past 65 years of weather bureau records, shows remarkably high coincidence of business recessions with the periods of elevated

temperatures, and of business booms during prolonged periods of normal or unseasonably low temperatures.

This basic dominance of all human function, and especially of economic activity, by the climatic drive, as body heat loss becomes easier or more difficult of accomplishment, deserves close attention and further study. With the rising energy tide of low temperature periods, busness activity expands. At the same time the signs of bodily stress increase and death and sickness rates rise. In the periods of ebbing energy general health improves as busness activity recedes to lower levels.

It has been man's failure to recognize this dominance of environmental stimulation that has made impossible a solution of the basic cause of economic cycles. Moreover. the irregularity of their timing has rendered difficult the perfection of plans for meeting the changes as they come

Fluctuations in the climatic drive. aside from the seasonal and irregular ones of short duration, have left their imprint on the history of nations back through the centuries The past two centuries of continuous temperature records vield an enlightening picture of the workings of this drive Outbursts of national expansion, as well as bloody revolutions for greater freedom of individual action, have shown an uncanny tendency to come during years of subnormal mean temperatures-years of the cold, stormy weather that drives men to greater activity

LONG undulations in earth temperatures have taken place and will undoubtedly continue in the future. Longest and greatest of these changes are represented by the glacial epochs and the intervening ages when tropical warmth spread well outward toward the poles. We are only perhaps 20,000 years away from the coldest part of the last glacial epoch, with a likelihood of generally rising temperatures for ten times that number of years to come The rise in temperatures has not been steady, however, but has come in 2000year waves The most recent high point came with the warmth of the Middle Ages (800-1000 AD), while the subsequent low point occurred about the middle of the 19th Century After 1850, world temperatures rose slowly and irregularly for several decades, but since 1920 this rise has become more emphatic. In 1932 the bodies of Vikings were being unearthed in excavations in Greenland after having been solidly frozen-in for almost 1000 years. And with this recent warming-up has come a sharp turn back toward despotic forms of government all over the earth. Man has felt weaker.

With the cold of the last century came a marked increase in world population and such an abundance of energy and inventive genius as had never before been witnessed in human history. Since 1920, how-ever, population increase in many of the most energetic countries has shown signs of tapering off, with statemen of several countries worrying about the possibility of an actual decline in numbers.

We seem, then, recently to have passed a crest in human affairs and to be headed for a considerable period of recession. The improvement in stature and trend toward earlier maturity, that has been in evidence during the past century, will no doubt be reversed shortly, for animal studies have clearly shown that these basic characteristics are closely linked to the ease or difficulty of body heat dissipa-

What shall we do about it all?
Disastrous fluctuations in business activity might be robbed of
their evils if we could predict the
timing of the energy tudes in man
that seem responsible for the economic swings. If the irregular
fluctuations in energy and trade
were as predictable as are the sea-

sonal ones, we would be much less disturbed by them and be more inclined to take them in our stride. for panic arises from fear of the unknown In the individual phase of weather dominance, however, much can be done to relieve us from the undesirable aspects of such influence Through newer methods of air conditioning and control of indoor environments, we can to a considerable degree alter the effects of outside weather People in the tropics can raise their energy level and bodily vigor almost at will through indoor cooling to allow ready dissipation of body heat So also can the physical and mental let-down of mid-summer in temperate regions be eliminated by proper cooling, although it is a question whether it is wise to forego this period of lessened effort when the body relaxes and recuperates for the strenuous winter

months to come
Much remains to be discovered
in this matter of weather dominance over man Humanity really
need not stumble blindly through
the centures, engaged in stupidly
fighting deep currents of change
which are based on forces whose
magnitude dwarfs to insignificance
man's puny efforts Is it expecting
too much to hope that man will
some day arrive at intelligent and
understanding co-operation with
these outside forces, instead of
putting up a futile resistance to the
changes they bring?

below the American Falls. It will be the longest bridge of its type in America, the next longest being the Hendrick Hudson Bridge across the Harlem River in New York City It will have one graceful structural arc across the Gorge and will have no superstructure other than the railings. There will be a wide promende on the southern edge of the

double roadway, giving a full view of both the American and Horseshoe Falls Traffic will be carried by two 22-foot roadways separated by a mail Of particular importance is the fact that the foundations for the new structure, in the face of the Gorge cliffs, will be high above any nossible ice-amo fit future.

CARBON IN CEMENT

Colloidal Carbon as a Grinding

Aid in Portland Cement

Manufacture

COLLOIDAL carbon, commonly known as carbon black, is an effective grinding aid in the manufacture of Portland cement, according to the results of research carried out by the Columbian Carbon Company's Industrial Fellowship at Mellon Institute, Pittsburgh

The report of this investigation discloses that a carbon dosage as low as 0 32 percent on the clinker increases the fineness of the cement by 30 percent when the time of grinding is constant, and that the same carbon dosage decreases the grinding time by 28 percent when the grinding is to iun constant fineness With a 1 percent carbon dosage, these improvements become 50 percent and 34 percent. respectively. In terms of power saving and increased output these results are of practical significance The cements prepared with carbon present as a grinding aid, compared to the controls, showed improved strength properties in tensile and compression tests on mortars These benefits are attributed in the main to the increased fineness of the cement, although there is evidence that the carbon, per se, is contributory The use of carbon in dosages up to 1 percent does not alter appreciably such standard properties of Portland cement as consistency, setting time,

TURKEY STEAKS

From the United States Department of Agriculture comes word of popular acceptance of turkey steaks. These steaks are small pieces of turkey meat and house-wives can buy them wherever turkey is sold by the piece They are usually cut from the breast, ½ to one inch thick

NIAGARA BRIDGE

Structure Over Gorge

Safe From Ice Jams

ALMOST directly on the site of the famous Falls View Bridge at Niagara Falls, which was destroyed by an ice jam in 1938, a new bridge was started in June This new \$4,000,000 project will have a main arch span of 950 feet across Niagara Gorge at a point about 2000 feet



Architect's drawing on photo shows how new Niagara Bridge will appear

soundness, color excepted, and has no noticeable effect on the resistance of cement mortars to freezing and thawing treatment

PLYWOOD PANELS

Large Size, Seamless,

Easy to Erect

Composite plywood panels in room sizes up to eight feet by 20 feet and faced with fabric have been announced by the Speedwall Company The giant size of these panels eliminates joints Ordinarily, one board makes a room wall, while



One-piece panel

four of them make a whole room Thus this Jumbo Speedwall, as it is called, saves erection time, and eliminates joint making on the job and the possibility of the development of cracks later on

This Jumbo Speedwall is made up of standard grade, water-reisstant, Douglas fir plywood panels, hot-press "welded" together with synthetic resin glues Surfaces to be decorated are sealed and "dressed" with a strong woven fabric, such as is often applied by fine decorators over many different types of surfaces. The special adhesive with which this fabric is applied also provides fire resistance and a moisture barrier for the wall when it is used.

PLATINUM

Metal Leaf Used for

Decorating Building Entrance

THE first application of platinum leaf for building decoration was completed recently on the outer vestibule ceiling of the 67 Wall Street Building, in New York City

Platinum leaf—latest product of the ancient art of gold beating—is beaten down to a thickness which requires a stack of 250,000 leaves to measure an inch in height Yet, when applied to a surface, the leaf provides a metallic effect with all the rich color and beauty of platinum. The metallic leaf was selected for the entrance because of its brightness, tarnish resistance, and freedom from discoloration by atmospheric conditions.

Platinum leaf has been available for several years for outdoor signs, interior decoration, bookbinding, and many other decorative uses

QUICK-FREEZE

Machine For Home

Freezes Foods

AMERICA'S first sub-zero locker box for the home has been named Deep-Freeze It is being built in one-barrel and two-barrel capacities and incorporates certain innovations in refrigeration.

Conventional refrigerators pull against a vacuum but the Deep-Freeze unit actually operates on the pressure side Tests have shown, it is claimed, that the Deep-Freeze unit requires considerably less current to produce zero cold than does conventional equipment.

The cooling element is unique. It consists of a double wall cylinder of heavy steel which serves both as the food box and as the cooling element. Freon refrigerant is circulated in the space between the cylinder walls, hence the entire usable interior space is surrounded by a refrigerant.

This new Deep-Freeze food locker was developed by W. L. Morrison. The one barrel capacity will be more generally used by urban families while the two barrel capac-



Quick-freezer for the home

ity might be used by farmers to provide long-term cold-storage facilities for meat and other fresh foods including vegetables. Sportsmen might use it for quick freezing of fish and other game.

CELLOPHANE CEMENT

A NEW Cellophane cement adaptable to food packaging has been placed on the market by Carmen Products It is described as transparent, tasteless, and odorless, moisture-proof, and resistant to acids and alkalis

RUBBER LOAD ROLLERS

THE ponderous iron road roller with its clanking, barrel-like rollers, is being displaced in some types of service by vehicles equipped with pneumatic rubber tires Use of the tires for road rolling has proved the best method of



Multiple pneumatic tires repiace the iron barrel of the steam roller



obtaining the equivalent action of heavy traffic compaction on road mix and rock asphalt surfaces, tests have shown Developed by The B F. Goodrich Company, the new tres are mounted in series with as many as nine or more to a single vehicle.

TRENCH MORTARS

And Shells Made From

Standard Steel Tubing

STANDARD seamless steel tubing can now be used to make trench mortars for the United States Army, according to Captain Daniel J. Martin, writing in a recent issue of Army Ordnance

Trench mortars are light weapons originally intended to be used
by infantry to blast the enemy's
renches They have been so improved that they have become actually light artility—very effective
for blasting out enemy machinegun positions Of the two types
used, the 60-mm mortar weighs but
39 pounds, while the 81-mm mortar weighs, assembled, 134 pounds
This latter mortar may be carried,
disassembled, by three men

Since trench mortars are smoothbore weapons and the powder charge is relatively small. Captain Martin explains that both the weapon and the shells it fires may be made of standard tubing From this it is obvious that manufacture of adequate numbers of these weapons can be attained rapidly and easily

CHICKEN PLUCKER

Machine Does Work

Ten Times Faster

PLUCKING the family chicken—or the game bird from your autumn hunt—will cease to be a burden if you have a new machine recently put on the market as a commercial

Above: Three-unit machine for removing chicken feathers. Below: Making the feathers fly



product However, since it's designed for mass production, you probably still will find that the old hand method is more economical in the home

Expert hand pickers in the poultry market can pluck about 35 or 40 birds an hour The machine will handle about 250 or 300—with some limitations Tail and wing feathers require manual attention But aside from that the machine will make the feathers fly Actual results in the Schulte Poultry Company in Cleveland largely have confirmed the predictions of the manufacturers that the equipment will revolutionize the industry

Essentially the machine consists of one or more metal drums, each about 2½ feet in diameter Each drum is bristled with rubber tube fingers, this in effect becoming a cylindrical rubber brush As this revolves rapidly it literally brushes out the feathers.

These flying wet feathers naturally are corrosive to many metals. Further, they tend to stick to the machine as they dry Because of the ease with which it can be cleaned, as well as its resistance to corrosion, the machine is made of Monel. It is manufactured by Mueller Metal Products.—INCO.

NON - SKID

Abrasive is Cast Into Metal Stair Treads

S.I.P.—Roor stairway treads, which incorporate an abrasive material penetrating the entire thickness of the plate, are a development of the National Bronze and Aluminum Foundry Company This abrasive, which is called Ten-Lox, is east in the metal in molten form to insure a perfect bond around each particle of the material These stairway plates are cast in any size or thickness and are easily installed on existing surfaces through the use of countersunk screws, bolts, or specially prepared mastics.

Ten-Lox shp-proof stair treads and floor the are impervious to the action of water, oil, and grease They can be furnished as cast, sand blasted, scratch brushed, or polished, with or without nosing

TIMBER PROTECTION

Impregnation of Timber With Arsenic Salts, New Swedish Method

Many attempts have been made to find suitable means of protecting tumber against ort and insects Fammon but, being only a surface preparation, it does not preparation, it does not prevent the body of the timber from taking up moisture, and therefore rot gradually appears even in painted wood

The effective components of a new Swedish impregnation method are certain arsenic compounds. The method has been developed by the Boliden Mining Company, in Stockholm, which obtains large quantities of arsenic as a by-product in the smelting of copper ore from its mines in northern Sweden

The impregnation liquid used consists of a solution of various salts, including arsenic After these salts have entered the timber, a chemical process takes place, with the co-operation of certain easily oxidized substances in the wood itself. The final result of this chemical process is the production of zinc arsenate and chromic arsenate, which become inseparably fixed in the wood, and constitute the effective elements against attacks of decay or insects.

Arsenic-impregnated timber is

said to retain its mechanical qualities. It takes on a soft green color with a alight shade of brown, which is sufficiently strong to render painting unnecessary if the timber is used in buildings. Another advantage is that the timber does not catch fire as easily, and burns less quickly than unimpregnated boards, thus contributing to damage reduction in case of fire.

The new method is said to compare very favorably in cost with other methods. In the Scandinavian countries, arsenic-impregnated timber at present is being used increasingly for various kinds of out-door purposes, including quay and other under-water constructions. Twelve impregnation plants in various parts of Sweden are employing the method, in addition to some in Norway and Denmark—Holger Lundbergh.

PIPE PROTECTION

Oil Pipes Covered

with Cellulose Sheet

EXPERIMENTS have been conducted in the Texas oil fields for more than six years by a major pipe-line company in an effort to find a protective coating material that would be physically and economically satisfactory for use on oil lines. From the many materials tested, there has emerged one shield of considerable promise. Pyralin sheeting.

In one test case, clear, transparent Pyralin 005 of an inch thick was used and in the other, black Pyralin 008 of an inch thick coat of hot asphalt was applied to a six-inch diameter pipe which was them wrapped with the Pyralin shield The line was replaced in soil known to be highly corrosive and inspected intermittently over a period of three years.

Final inspection of the two sections showed that both the clear and the black Pyralin had remained free from chemical or physical change Considering that a price differential favored the black material, it was decided to select that color for future work, and to use 01 of an inch thick material as a safeguard against breakage from clods and rocks in the trench bottom.

Pyralin is not appreciably affected when exposed to damp atmospheres or immersed in water, reports The Du Pont Magazine. Under normal conditions it will absorb only about 3 percent of its weight. In addition, it is only slightly affected by weak acids and weak alkalies Experiments show that it remains smooth and hard when underground: that when earth surrounding the pipe contracts due to change in temperature, it slips away, leaving the wrapping unharmed. The material



has the required rigidity and yet is pliable enough to permit easy application

To obtain a tight fit around obstacles such as collars and girth welds, the sheets are first softened in a liquid solution of one part ethyl acetate, three parts slochol, and four parts water The Pyrain expands, when softened, but upon dryng shrinks a greater amount, making possible a tight form fit on sections of irregular shape.

HEREDITY RULES

Despite Science's Attempts

To Change a Fly

FIFTEEN years ago a normal fruit fly of the species Drosophila was mated to a female with degenerate wings From their descendants a sımılar pair were chosen and mated, the male normal in every respect, the female with vestigial wings This procedure has been repeated for 300 generations, the equivalent of 9000 years of human life, yet today the genes that produce normal wings in this fly are still functioning, stubbornly refusing to be bred out of existence or changed in their action -The Industrial Bulletin of Arthur D. Little Inc.

MOTORIZED TILLER

Machine Shreds Soil in

Seed Bed Preparation

A NEW motorized garden tiller, which is steered by handles like an



Left: Shredding garden soil with the motorized tiller. Abore: Rotating times that do the work

ordinary plow but which is completely motorized, is the product of the Ariens Company. Ariens Tillers are used by truck gardeners, greenhouse men, city parks, nurseries, and the like, for they are ideally suited for these applications as well as for small farms.

A particular feature of this tiller is the group of rotating, sharply pointed times under the hood at the rear of the machine. These times literally tear the soil to shreds, thus making it unnecessary to plow and then to disk and perhaps to harrow a seed bed being prepared. The machine operates equally well in tall weeds which it rips up by the roots. It is particularly adaptable to the job of tilling soil between shrubs or in other restricted or confined spaces.

GLOWING CARPETS

Carpet Fluoresces:

Lamp Activates It

CONCIDENTALLY, there comes to our desk news of two complementary developments. The first concerns a new "magic carpet" which glows in the dark under the invisible "light" from ultra-violet ray lamps The other concerns development of a lamp for activating such carpets, making them glow, in such locations as the aisles of darkened theaters

theaters

The new carpet was announced by H E. Millson of the Calco Chemical Division of the American Cyanamid Company He explains that the carpet is dyed with special dyes which appear quite ordinary in daylight but glow softly with various colors under invisible ultra-violet rays Hence, it will be of value in providing an extra safety feature in theaters

The Continental Lithograph Corporation announces the other development — new Conti - Glo Black Lights which were designed specifically for this use. Formerly black light equipment gave spotty results whereas the beam pattern of the new one is very long, narrow, and exceedingly sharp in cut-off at the edges.

DRINKING WATER

Need For Better Water

Pipe Inspections

BESIDENTS of Johet, Illimois, a few months ago found their drinking water strangely flavored with beer and soda-water flavors. The reason was a cross connection between city water and a private supply in two breveries and two soft-drink bottling places which permitted backflow into the city mains.

Reporting this occurence to the trade journal, Plymbing and Heating Business, A R McGonegal, formerly plumbing inspector for the District of Columbia, points out that "poisonous solutions such as aerd copper-cleaning compounds might have been drawn into the mains by a drop in pressure just as easily as here."

Renovation of water piping in industrial plants all over the country is a health necessity, according to recent reports from public health engineers. Their reports refer to conditions during normal times but the situation probably needs attention more urgently than ever, now that industrial production is being speeded up for national defense, with consequent extra loads on plumbing and piping

FEEDER ROADS

Surfaced with Cement

MOTORING around the country, you soon may be riding on a "dirt" you soon may be riding on a "dirt" and with the common of the made with cement! Already, in 29 different states, sections of this new type of road have been installed, using a method of construction which engineers thought impossible only a few years ago, according to only a few years ago, according to only a few years ago, according to a few years ago, according to ender sections of roads where the \$20,000 to \$40,000 per mile for concrete construction is not justified

For years, specifications for making concrete had prohibited use of material containing more than 5



Above. Spreading cement for resurfacing a dirt road. Below. Cutting the cement into the dirt



percent of dirt. However, some experiments in South Carolina in 1933 and 1934 indicated that under some conditions it might work. Under the direction of Frank T. Sheets, then director of the development department of the Portland Cement Association, and Miles D. Catton, studies were conducted and formulas and tables were developed to guide future builders.

In building a soil-cement road the first step is to take samples of the soil and test them. These tests show the proportions of cement and water to be used. Road work begins with a scarification of the old road to a depth of about six inches with rake-like devices hauled by a tractor A disk harrow then pulverizes the surface Portland cement in pre-determined amounts is then spread over the road and this is cut into the loose surface by disking and with gang plows drawn by tractors Water is then added under pressure in carefully controlled amounts, and harrows, plows or cultivators again go to work. The surface is then packed down, graded, and rolled. After slow drying for about a week, the road is opened to traffic, though about a month is required for the road to "season." Sometimes a thin asphalt layer can be applied to give the proper riding surface, though this is not necessary as a protection.

FLOWER POISON

Cut Flowers Keep Best In Absence of Fruit

By rule of thumb, florists have thought for years that cut flowers would keep better at a refrigerator temperature of 50 degrees Actually, they keep better at a near zero temperature, though florists who stored cut flowers at that temperature usually found that the flowers would not keep The Department of Agraculture has found the "ingger in the wood pile"

when the florists stored carnations at just above freezing, it isually happened that storage space was in a warehoust for a storage space was in a warehoust for a space contains given off by apples in storage and ethylene gas is poisonous to flowers That is true even when minute quantities of the gas are present as in the case where flowers are stored in a warehouse which formerly contained apples

GIANT ARC

Quenched by Compressed

Air Blast

A POWERFUL blast of air racing six times faster than a tropical hurricane recently blew out an electric arc powerful enough to light for an instant all the lamps in Chicago

Surging with 150 pounds pressure from a container not much larger than an automobile gas tank, at a speed of 600 miles an hour, the gust of compressed air extinguished an arc of one and one half million kilvoit-amperes in approximately one one-hundred-and-twentieth of a second Only a slight puff of smoke trailed off as a remunder of the once powerful arc.

Executives and engineers of electric power, industrial, and transportation companies from all over the country witnessed this unique demonstration of a newly developed compressed-air circuit breaker at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. L. R. Ludwig, manager of the company's air circuit breaker engineering department, said this test

MISCELLANY....

represented the greatest amount of power ever interrupted by a 15 .-000-volt commercial breaker operating in air.

One of the functions of a circuit breaker can be likened to a fuse on a power system to open the circuit in case of trouble on the line and prevent its reaching the power house. The other is that of a disconnect, comparable to the wall switch at home, which enables the power engineer to open and close

power circuits at will Essential parts of the breaker include a tank of compressed air at a pressure of 150 pounds per square inch, valves and pistons to operate the air mechanisms, contacts, and arc chutes or fan-shaped interrupting chambers All of this mechan-

a household refrigerator The new circuit breaker quenches in a few inches of space an arc that theoretically would have to be pulled out some 40 feet to be extinguished in ordinary air

WATER - SOLUBLE

New Waxes are First Completely Water Soluble

T wo recently-introduced products should be tempting to experimenters interested in testing each new kind of substance in the hope of finding distinctive properties to impart to existing articles. One of these substances, reports The Industrial Bulletin of Arthur D Little, Inc , is physically like petrolatum and the other resembles a wax of 125 degrees melting point. but both have solubility properties that are unique. They are the first waxes completely soluble in water. forming solutions as transparent as water itself While readily soluble in benzene and toluene, the acetates, and acetone, they are not appreciably soluble in naphtha or other petroleum products, or in turpentine, waxes, or fats Odor and taste are slight, and preliminary tests on animals indicate that these products are harmless, at least when applied externally.

The waxy or greasy feel suggests slip or lubricating action, for uses. where actual greases are not wanted. For these and other applications they can be applied as clear water solutions

The producers, Carbide and Carbon Chemicals Corporation, suggest the soft form as a plasticizer for casein, gelatine, or glue; in

ANY BOY can make a motor

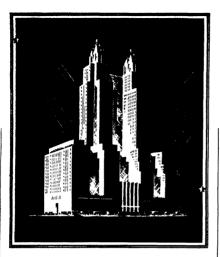
by Westinghouse



- · For a thing so important to modern life, an electric motor is an amazingly simple device Just a few pieces of steel, iron and copper, wound with coils of wire Any bright boy can follow instructions and make one that will run.*
- Yet the most romantic story ever told could be written about the electric motor. It runs practically every mechanical device in use today. It turns the wheels of industry. It carries people to work from the suburbs to the topmost floors of tall buildings. It changes housekeeping from dreaded drudgery to delightful adventure. Our daily lives and livelihoods depend-more than we realize-upon the smooth, effortless spin of a thousand electric motors.
- common nowadays that we accept them as our primitive ancestors ac-
- · In fact, electric motors are so

- cepted air, water and fire. We flick a switch-and an automatic razor zips off our whiskers. We push a button-and our automobile motor starts. A faucet turns-and a faraway pump delivers water. A vacuum cleaner cleans, an electric fan cools, an adding machine adds, a phonograph plays-and it's all automatic, as far as most of us are concerned.
- · We have been making electric motors for a great many years-in fact we've made millions and millions of them. Naturally, we have improved their design and construction considerably since 1886. We can remember when we thought a 1/4-horsepower motor, which took up more than a cubic foot of room. was a pretty commendable achievement. Now we can pack the same horsepower into a third of the space, sell it for less, and save the user a big dividend in operating cost.
- · But after all, it's fitting the motor to the job that really counts. A 1/4-horsepower motor and a 10horsepower job just can't be combined. Neither can an oil rig and a motor designed for an air conditioning system. That is why Westinghouse offers stock motors in thousands of types, sizes and ratings. And if none of these is exactly what is needed, a special model will be built to order.
- · The electric motor is "bread and butter" to us-and to almost everyone else. The more we learn about the jobs it can do, the more we can add to its usefulness. Meanwhile, we keep right on with the testing, experimenting and improving that have helped to make the electric motor the unsung hero of American progress.

Maybe you know a bright boy who would like to have us send him a little book telling how he
can make a toy motor that will run. Just write Westinghouse, 306 Fourth Avenue, Pittsburgh, Pa.



A Partnership of SCIENCE and ART

If there is such a thing as a hotel being the expression and the essence of the finer aspects of the life of a city, surely it is no immodesty to claim that distinction for The Waldorf-Astoria

Here, not only the art of living luxuriously, but the science of living wisely and efficiently, and therefore economically, come to fruition in such a totality of advantages as only art and science together could achieve.

Science is the source of its creature comforts, but what most endears it to the world is its knowledge and its practice of The Art of Home!

THE

WALDORF-ASTORIA

PARK ALENIA . ASTR TO SOTE A NEW ACCES

CVVVO

-MISCELLANY-

various binding and film-forming applications, as a lubricant for rubber: as a softener for beltdressings; and as an ingredient of air-scrubbing liquid, in addition to cosmetic application in creams, lotions, and hair preparations. The hard form has binding properties applicable to films, and its surface activity favors suspension of pigments and lakes. This combination of pigment-holding and binding properties offers possibilities for water-soluble, temporary marking crayons and paints, and even for calcimines, grease-proofings, and dressings Many other kinds of uses will undoubtedly be discovered by experimentation

ENAMEL REMOVER

Non-Caustic, Floats off

the Surface

An opaque liquid about the color of cream, and celled Metastrip, strips baked enamels, varmishes, lacquers, paints, and even the latest synthetic finishes from all kinds of metals. The asimple emulsirying action to the color of the color o

No special equipment is required for using this agent. Metastrip is maintained at a heat of about 190 degrees to 213 degrees, Fahrenheit, and the work is simply immersed in it. When removed in about two minutes, the metal has a clean, bright surface.

Metastrip is made in two strengths, single and double For average work the single is recommended.

HOLDING TOOL

Magnetic Holder For Small Parts in Production

ADAPTATION of the principle of the magnetic chuck to a new magnetic tool has been made by Brown & Sharpe Manufacturing Company. This tool, which seems merely a block of metal with a knurled wheel at one end, constitutes a holder of very small magnetic parts which would be distorted or marred in some way if held by the usual vise. Iron or steel work wide enough to span the narrow insert in the top of the block can be held firmly on

it for testing, inspection, and hand operation.

The knurled wheel revolves a magnet inside the block In one position the magnetic flux moves only within the body of the block When the wheel is turned in the "on" position, the polarity of the



magnetic flux is so changed that one field passes up and over the insert in the top of the block, continuing its circuit through the "work" The opposite field of flux passes downward and through the conductive surface on which the block rests so that the block is held as firmly as though in a vise, and it, in turn, holds the work firmly on top

CULT SNAKES

Why Cultists Prefer

Copperheads to Rattlers

COPPERHEAD snakes are less deadly than rattlesnakes, water moccasins, and coral snakes. This may explain why followers of the Holiness religious cult in Georgia have been able to handle copperheads in their church rites with apparently few featilities.

The bite of the coral snake is.

The bite of the coral snake is venow of this reptile attacks the nerve centers. The venom of rattlesnakes, moccasins, and copperheads, on the other hand, destroys red blood cells and breaks down the walls of the blood vessels. Serious as this condition is, it takes a little longer period before it becomes fatal, giving a chance for the victum's recuperative powers and medical aid to overcome the effect of the snake

Copperheads are very dangerous and there are records of deaths from the bite of this snake, but such deaths are not common The reasons why the copperhead is less dangerous than the rattler are that the copperhead has shorter fangs, less virulent venom, and be-

cause of its smaller size, injects a smaller amount of poison into a bite.

The habits of the copperhead may also have helped to protect those who handled it in religious rites. This snake is very quiet, seldom striking unless very definitely annoyed or attacked.—Science Service.

RADIO FIRE TRUCKS

F A fire department has no quick means of calling for additional help, or if it is unable to notify the apparatus of an error made in the location of a fire and the trucks have to make an unnecessary run before finding this out, then the department is not utilizing its apparatus with the greatest efficiency If the department cannot send apparatus back to the station when it is found that they are not needed, or if it cannot shift equipment and men from fire to fire, the department may be said to be operating at lower than its maximum efficiency Through the increased use of the radio, this condition is being steadily improved Two-way radio has made possible the operation of a department as a closely co-ordinated, yet flexible, unit, free from confusion and lost motion -Fire Engineering

CHIME - CARILLON

Gives Impression of Costly Belfry Carillon

What is said to be the world's most accurately tuned carillon is now being produced by the Sundt Engineering Company. This instru-



ment is an amplified, 25-chime, 37note, keyboard-operated, tubular, chime-carillon The keyboard is played like that of a pano. Large outdoor speakers mounted in a church belfry give the impression of a large and costiv bell carillon.

The Sundt carillon is tuned to



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such close accuracy that it eliminates the out-of-tune sound so frequently occurring in outdoor carillons when two or more notes are played together. Special electric pick-ups on each chime pick up the deep sub-octave bell notes which are amplified separately. In this way the range is extended a full octave Microphones pick up the usual chime note. The two are blended by foot pedals to obtain unusual "distance" effects and varia-

Although the total weight of the Sundt carillon is only 600 pounds, the deepest note it produces equals the tone produced by a bell of 12,500 pounds

HYDRAULIC

Coal Mining With a

Pressure Tube "Explosive"

HYDRAULIC pressure is now being used in coal mining to take the place of explosives usually used Results of tests made over a period of about two years have been promising enough to warrant the du Pont Company placing this process on the market in a limited way

The hydraulic mining process is basically simple After the usual holes are drilled in the coal face a special tube, closed at the end, is inserted. The protruding end is connected through an electrically driven pump to a storage tank containing a special oil. The pump drives the oil under very high pressure into the tube inserted in the hole, the tube expands under the great pressure, and the coal face is broken down.

In other words, the pressure exerted causes such expansion and resultant enlargement in diameter of



Inserting a hydraulic mining tube in face of a coal vein



Close-up of the mining tube

the tube that the coal is broken free along its natural parting lines, without explosion, flame, or the evolution of fumes or smoke.

The mining tube itself is of rubber with a relatively small hole and a thick wall, and is covered with a steel braid that both protects it and prevents its runture

Experimental work on this new method was conducted by the du Pont Company in a number of mining areas The most extensive tests have been made at the New Monarch Mine of the Consolidated Coal Company at Herrin. Illinois

OIL

U-V Rays Detect It

In Mud From Wells

New aid to rotary drillers in finding oil-bearing formations is the ultra-violet ray. Inventors say it detects instantly minute quantities of oil invisible to the naked eye in drilling muds.

After mud has travelled down through the hollow drill pipe, passing out through the drill, bringing cuttings back to the surface, a beam of ultra-violet rays is focused upon it. The tiny perticles of oil, if present become fluorescent.

WARSHIP SPEED

Italians Test

Unfinished Ships

M UCH has been written in recent years of the success of the Italian Navy in building enormous speed into Italian warships Almost invariably trials of cruisers and destroyers show speeds several knots higher than those in comparable vessels of other navies. It is to be wondered if those high speeds are all to be explained as may be that of the 10,000-ton cruiser, Zara. We



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MISCELLANY-

quote the following paragraph from Engineering (London) regarding the trials of that ship.

"A photograph from the air of the 10.000-ton cruiser Zara on trials showed that she was minus the whole of her main armament, including not only the guns, but the turrets themselves. In such circumstances, it is not difficult to attain remarkable trial speeds, but the assumption is reasonable that another year, at least, would be required before the vessel could be regarded as an efficient fighting unit, fit to take part in any combined naval operations."

COPPER PLATING

Immersion Process

Is Simple, Economical

OFTEN a coating of copper is destred on metal quickly and more economically than is ordinarily obtainable by electro-plating Use of Cuprodine solves the problem This is a powdered chemical which is employed in much the same manner as ordinary copper salts but produces a denser, more adherent, and more lustrous coating. The process is particularly adaptable to the job of coating round wire to reduce the wear on drawing dies

The Cuprodine process is simple The surface to be copper coated is first pickled and then rinsed. It is then immersed in the Cuprodine solution until the coating is completed, which may require from 10 seconds to two minutes depending upon the nature of the steel or the thickness of the coating desired

TREES

Personal Histories

Suggested

THE life history of a single tree may not seem particularly important, yet such a history, if complete in many details, would make not only an interesting record for future generations but conceivably might supply scientists of the future with facts regarding tree growth that would be valuable to them

Professor Ralph G Unger, of the New York State College of Forestry, at Syracuse University, recently suggested that such personal histories of trees might be made by many persons. Under his plan, the common and scientific names of a tree-perhaps one planted for



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METAL CAST PRODUCTS CO 6 Boston Road New York City shade purposes in a vard-would be recorded: other facts would include the origin of the tree, the date and age when planted, and by whom Thereafter an annual record would be kept of the diameter in inches, height in feet, crown spread, disease and insect attacks. any injuries, extent of seed crop. and similar details. These records would be handed down from generation to generation in a family. or from owner to owner

Professor Unger urges adoption of this plan because, as he says, "our historical trees are disappearing rapidly . . . and the young tree of today may become important historically in the future."

LOCOMOTIVE RECORDER

Checks Engineer's Alertness

to Signals

To provide railroad officials with a graphic record of their engineers' alertness to running signals. Valve Pilot Corporation of New York City has developed an Automatic Train Signal Recorder

Where railways are equipped with automatic block signals, a



train will stop automatically if it runs past a caution light. By moving the so-called forestalling lever. the engineer forestalls this automatic application of the brakes and then proceeds in accordance with the instructions flashed by the signal Ordinarily his superiors have no record of this action, but if the locomotive is fitted with an Automatic Train Signal Recorder, a record is made automatically each time the engineer forestalls

The instrument consists of a pencil attached to the armature of an electromagnet. When the engine-

man forestalls, a warning whistle in the cab sounds off. The rush of air to the whistle closes an electropneumatic switch which sets up an electric current in the magnet and causes a pencil on the armature to make a mark on a paper tape.

The Automatic Train Signal Recorder is housed in the Loco Valve Pilot instrument which indicates and records speed and cut-off control. From one unit, therefore, there is obtained a record of the engineer's attention to three important operating factors efficiency, speed, and safety,

FIRE ALARM

Self-Contained Unit

Rings a Loud Gong

A DEVICE no larger than the hand and employing mercury as an activating agent conceivably might save many of the 10,000 lives that are annually sacrificed through fires in American homes

The life-saving invention is an automatic fire alarm, complete in itself, which sounds its warning almost immediately upon the outbreak of any fire in the area which it guards The alarm functions through the thermostatic action of a tiny mercury switch When the temperature about it reaches a degree which indicates the presence of fire, the mercury switch sets off a gong of sufficient volume to arouse the household, even from the deepest sleep

Since the new alarm is so small in size, it can be hung inconspicuously on walls or laid upon dresser or table—and the price has been made sufficiently low that the average family can place several units in danger spots throughout the home without any strain on the budget

LABORATORY RUBBER

Another, of Superior Quality,

Added to List

THE newest of the synthetic rubbers, Chemigum, has just been announced by Goodyear as a result of several years research. A new plant having an initial capacity of 10,000 pounds per day is being installed at Akron

Chemigum is derived from petroleum through a cracking process, and tires made of it are said to give superior performance to those made of German Buna. In



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MISCELLANY-

fact, the manufacturer claims that such tires are equal to those of natural rubber. Like other artificial rubber, however, Chemigum at present costs more than natural crude rubber Nevertheless, its increased tensile strength, resistance to aging, abrasion, and oils, and the fact that it may be processed more easily than Buna, make it important industrially It also has possibilities for blending with natural rubber, so that it might help in an emergency to eke out slender supplies of the natural product

SAPPHIRES

Wor Cuts Down Supply

For Industry

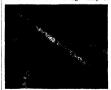
Synthetic sapphires, important for use in jewelled watches and many industrial instruments, are becoming scarce, as we have had to import them from Switzerland, France, and Germany

These gem stones have been made since 1902 by the Verneuil process which fuses alumina The globule which is obtained is split and sliced into thousands of tiny newels Those used in watches are of small diameter and almost paper thin. The price of these ranges downward to about one and onehalf cents each

TUBULAR LIGHT

Smaller Fluorescent Tubes For Restricted Spaces

WITH fluorescent lamps becoming more popular every day, the need for a small low-wattage lamp of



this type for use in limited space has been filled by the production of one only nine inches long. This new lamp is of six-watt capacity. is available in two colors—daylight and white-and sells for \$1.15. It is expected to find applications in illuminating business machines, curved showcases, and airplane cabins, in bed lamps and the like.



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Strange Guns in Strange Places

N 1855, General William Walker, In 1855, General William Tourist soldiers of fortune, simultaneously reached the ripe old age of 32 and the shores of Lake Nicaragua, in the country of that name With his "expeditionary" force of 66 men, he appropriated a boat from The Accessory Transit Company, a Coinelius Vanderbilt-controlled freight and passenger line, captured the key city of Granada, and made himself master of Nicaragua For five years his star alternately flared and dimmed It was completely extinguished with his execution in 1860, but the name of William Walker was forever engraved in Nicaragua's history, and elsewhere, as will be seen

Uprisings, rebellions, punctuated by short periods of quiet, beset the little country until 1927, when President Coolidge's emissary, Colonel Henry L Stimson, brought peace to the rival parties Government troops and rebels were both disarmed under the treaty, which provided \$10 Nicaraguan money and an honorable discharge to each officer or soldier who surrendered anything that would shoot The U S Marines had charge of this collection of arms, of which there were thousands They consisted ancient Spanish brass cannon. modern Thompson sub-machine guns which were in the hands of Nicaraguan rebels before our Marines ever saw them, flintlocks, cap-and-ball revolvers, and modern Springfields Where all the guns came from, no one knew, but among them were collectors' pieces by the bull-cart load A request was made that such arms be saved, either for an American museum or for the Nicaraguan National Museum It was denied and three box-car loads of surrendered arms were destroyed under American supervision.

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about \$25 in good condition, about \$75 in what collectors call "fine" condition As antiques go, it was no show piece, but what attracted Chapel's attention was that, in addition to the usual markings, the barrel was engraved with the name "William Walker"

"My grandfather," said the collector, in response to Chapel's question, "whose name was Walker, carried it in an inside pocket as a personal weapon during the Civil War"

Chapel grinned, asked his friend what he knew of Nicaraguan history



Courtesv Colt's Patent Pirearms Mfg Co "Baby Dragoon"

Under cross-examination the collector broke down, admitted he had bought the gun from a dealer and hat the ancestral story was pure hokum. Then Chapel told his friend a bit of the gun's history and tried to buy it, but the collector refused to sell, even though there are plently the market like it—like above for the engraved name, "William Walker".

"How do you happen to know so much about this particular gun?" asked the collector.

assection of the control of the cont

Was than 1848 old meraved 'Willlam Walker's she would-be conqueror's personal run.' Where was it during the 67 years from the filbuster's death to the surrender of Nicaraguan runs in 1827 How did it escape the supposedly all-consuming fires that destroyed the other surrendered arms at Managua. How did it get into the hands of an American dealer in antique arms? These questions may never be answered, but

----ARMS AND TACKLE----

they show in part the color and romance of gun collecting. Has anyone else a story about "Strange Guns in Strange Places"?

Note Charles Edward Chapel retired from active service as 1st Lieutenant in the U S Marines Corps in 1937, after having served in China, Nicaragua, and other points since 1926 His book "Gun Collecting" now has a companion piece, "The Gun Col-lector's Handbook of Values," both of which are essential to amateur and professional collectors of antique arms A publisher as well as an author, Chapel's latest production is a second printing, limited to 1000 copies, of Charles Winthrop Sawyer's "Firearms in American History-Vol 2-The Revolver, 1800-1911" Sawyer, still regarded as the Dean of American arms historians, wrote and published his first edition in 1911. It sold rapidly and is extremely rare today _Fd]

Behind the Trigger Pull

In the intricate science of firearms manufacture, it's little things that count Take, for example, 1/600 or 1/700 of a second which clapses from the moment a shotgun hammer is released by trigger pull until the firing pin detonates the percussion cap Doesn't sound like much, but multiply it by 800,000, the number of tests rounds recently fired by Federal Cartridge Company in a Savage shotgun and you will find that the hammer of that test shotgun was in downward motion a total of 22 minutes, 13 seconds "So what?" you say, for no average shooter will live long enough to fire 800,000 shells. Why, that's a box of shells a day for 87 years and 245 days!

So, this When you buy an American-made shotgun, you can be confident the gun will stand up, that it will give you a lifetime of satisfactory service Neither Savage Arms Corporation, nor any other American arms maker expects Mr Average Gunner to burn 800,000 shotgun shells, nor do they anticipate the hammers of their guns will be in action 22 minutes and 13 seconds, but they do expect their products to perform satisfactorily To that end, the arms-rifles, shotguns, handguns—are tested far beyond the potential possibility of their use, and actual firing tests are by no means the only indication of solicitous care in manufacturing processes.

On a recent visit through the Savape plant we passed row after row of assembly work benches, and we noticed that every vise which was holding a gun part was carefully padded to prevent scratching or otherwise calamagng the part. We saw hundreds of wheel-equipped racks, built to transport highly polished stocks, shmy gun barrels, or complete guns from one department to another, and every one of these racks was also carefully padded Particularly fine stocks were protected from mars or dirty soft



flannel bags in which they traveled about the plant until they became a part of a beautiful new gun, and then the gun itself went into a bag formation and the safety and process. All food of the process of the proces

Simplification of operating mechanism in modern arms is another of those "little things" which years of scientific study have accomplished. If John Q Gunner had to manipulate an old flintlock, which contained 22 parts, or a muzzle-loading lock of 15 parts, he'd have something to worry about Even the breech-loading hammer gun lock has 17 parts, and certain types of high grade hammerless guns contain from seven to 22 working items in the lock By comparison, the Fox Lock, a Savage Arms product, with its three principal working parts, is simplicity personified There's the coal spring, the one-piece hammer, of which the firing pin is an integral part, and the That's all sear

There are thousands of other examples of scientific advancement in the history of American-made fire-arms It's a record to be proud of. The American lover of guns, whether for target or game shooting, is the most fortunate gunner in the world, for he has a limitless line of guns from which

to choose. He has, at his command, a corps of manufacturers, research engineers, scientists, and skilled artisans who persistently endeavor to produce better firearms at moderate cost. Best of all, he has, with few minor restrictions, complete freedom of use of his rifles, shotguns, and handguns. So, Mr John Q Gunner, when you take your gun affeld this fall, just remember of the state of the

October Boss

As the prize short-short story, we nominate the motto, "Fish and Feel Fit," adopted by The Associated Fishing Tackle Manufacturers, used extensively by South Bend Bait Com-



pany When you analyze that slogan, you find it tells all At this time of year the word "fish" conjures up for saltwater anglers visions of striped bass, weakfish, channel bass, bluefish, and

GUN COLLECTING

By Charles Edward Chapel
(1st Lt. U. S. Marine Corps. Retired)

Any gun fancier who has never ridden the hobby of firearms collecting will, in all probability, reach the last page of this book with the firm resolve immediately to inaugurate his hitherto neglected gun gathering activities. A pleasing, narrative style smoothly rapidly motivates the presentation of historical and informative data on antique arms and the pleas ure and profit to be had from their ership. Although written for the novice, and therefore equipped with an excellent glossary, index, bibliography, and source lists of collectors, museums, and periodicals dealing with the hobby, the veteran also will find this volume well worth adding to his library. (232 pages, 5 by 71/2 inches, 15 illustrations.) - \$2.60 portpaid.

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-ARMS AND TACKLE-

many others. To the fresh water Waltonian, those four letters bring mental pictures of pike, pickerel, walleyes, black bass, and huskie muskies, all of which have been rejuvenated, imbued with new fight by Autumn's cooling waters.

The second word in the slogan isn't really necessary, but it's euphonic, and it provides the suspense angle in this short-short tale "Fish, and..." And what? Ah, those two last words, "Feel Fit." They're the ones that settle the suspense, if any, and provide the logical, truthful, satisfactory, hammer-home-the-point climax.

It's difficult for us to imagine how any two-fisted chap could fish and not feel fit, but we claim those two words form a "logical" climax, because any



OCTOBER BASS
Rod by Heddon
Reel and line by South Bend
Plug by Shakespeare
Bass by Ye Editor!

angler knows that one reason he goes fishing is to feel fit When he accomplishes his purpose, he's proved his point It's a QE D The same words comprise a "truthful" climax When you tose that plug into the muskee's lair, tinged with reflected colors of the Autumn forest, or when the sali spray crisps your face the sali spray crisps your face the from October to the sali pray crisps you face to the from October to the sali pray crisps you go to the sali pray crisps you go to the sali pray crisps you for sali pray crisps you was the from October to the sali pray crisps you was knew You have to feel fit.

Those two words make a "satisfactory" conclusion to the short-short tale Most of us like happy endings, and what could be more satisfying than to "Feel Fit"? And if it isn't a "hammer-home-the-point" climax, we never saw one! When you think of the phrase, "Feel Fit," don't you vision a Dempsey in his prime, a 4-times champ, Bobby Jones; a Tilden, aceing through the field, an unstoppable Ty And aren't they all sort of Cobb? rolled into one and a part of you,--when you "Feel Fit"? All this is just another way of saying there are still several good weeks of fishing before we pack away the tackle. If you'd like proof, take another look at that October bass. The picture vividity brings to mind the cool of a fall evening, the graceful fight of the plug, the smashing strike ... and then, did I Feel Fit!

Butte

Ene of the surest ways to start an argument among a group of surf fishermen is to ask an apparently innocent question regarding the relative merits of spring butts and club or extension butts for surf rock.

Confirmed spring-butt addicts will rise to the batt, claiming that this type, by far the older form in the comparatively young art of surf casting, permits the surfman to gain greater distance. This, they will insist, is due to the spring action which brings out more of the rod power, and hence throw leaf farther.

include the state of the state

One of this country's leading craftsmen in the field of hand-made surf rods, Charlie Maltby, has held forth on this subject for long hours with the writer When a cast is made with a spring-but rod, says Charlie, the entire rod, from tip to butt, approaches the form of a slim letter "S" as casting power is applied. Then, as the lead sails seaward, the bend of the butt part of the "S" reacts and causes the tip to vibrate

Here is a field that offers opportunity for study by some scientifically inclined surfman Perhaps one angle of approach would be to take slowmotion pictures of a good surf caster using first a spring-but rod and then a club-butt stick Analysis of such pictures might reveal facts that would substantiate or disprove theories— A PP casting for AD R.IV

POT-SHOTS At Things New

STOEGER ARMS CORPORATION'S advance information on their 1941 Catalog-Handbook indicates the publication will be most ambitious in Stoeger's long history and will more than ever merit its designation as "The Shooter's Bible" New volume will show 4700 revisions from 1940 edition, as well as replacements for many items made unavailable by changing world conditions Gun tools and gunsmithing section will be one of most comprehensive ever published; hunting clothes, accessories and book section will be larger; over 100 pages will be devoted to gun parts for American guns; ballistics tables have been thoroughly revised As virtually all

S K E E T

and how to

By BOB NICHOLS

To the skeet devotee this book will be a friendly, helpful critic in pointing out possible existing faults of form, stance, fit of gun, target lead, and other factors which may have tended to interfere with perfect scores. To the inexperienced skeet shooter it will be a complete and competent guide to the above named phases of the sport, as well as to choice of guns, constructive suggestions and extensive information on eyes and shooting glass-es, clothing, field lay-out, and the entire game from station one to station eight. The author writes in clear, graphic style, gained from his own extensive experience in skeet shooting and from his knowledge and background as Arms, Ammunition and Skeet Editor of Field and Stream. (177 pages, 6 by 91/4 inches, 46 illustrations.)—\$3.60 postpaid.

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-- ARMS AND TACKLE-

prices have changed due to rising costs and governmental taxation for national defense, new figures will be shown here for first time In all, more than 18,000 items, accompanied by 6000 pictures, many in color, are described and priced in the 1941 Stoeger Catalog-Handbook wiffundt our annual could be shown that the story of the color of the

GRIFIN & HOWE, INC., announce their new "Zero-Rig Telescope Mount," which is a new and radically simple fixed mount for all standard 'scope sights. Once 'scope is set at zero with Griffin & Howe rig, it remains at zero, regardless of how often sight is dis-



mounted "Zero-Rig" embodies a firmly fitted, square shoulder joint with large, flat-headed screws to hold each bracket arm and "soope ring in secure contact. By removing these two flush-set screws, "soope and clamps can be lifted from the fixed base to leave top of the rifle clear for aiming with other sights. We have describits folders.

FREE BOOK LISTS. We have read and reviewed many interesting and informative books and other publications in the fields of firearms, fishing tackle, natural history Reviews have appeared in Scientific American's "Our Book Corner" and publications have been mentioned in this department under "Books of the Moment" For your convenience, we have prepared lists of the books thus covered. showing titles, authors, prices, and a line or two of explanation. If you'd like one or more of these compilations, drop us a line and specify your desires Only cost is a 3-cent stamp for return postage (Note Gun book list includes "History of Colt Re-volvers," by Haven and Belden, sponsored by Colt's Patent Firearms Manufacturing Company, and hot off the press September first)



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Letting George Do It

"por" goes another myth-the degeneracy of the photo-finishing plants. There is widely current the time-worn notion, frequently based on fact, that he who seeks the "drug store" finisher deserves what he gets sluggish work for sluggard workers But the truth is that there are good photo-finishers and there are ones, just as there are good and bad



One corner of the film drying room in the Pavelle Laboratories

photographers and good and bad any-In order to obtain a cross-section

picture of photo-finishing plants in general, we recently interviewed Leo S Pavelle, head of Pavelle Laboratories. Inc. an organization offering specialized plus routine service, and Nat Derfler, head of Royaltone, Inc. which serves the routine snapshooter class In the latter type of finisher, all work in the plant is geared to mass production-prints in seven hours-whereas the former stresses quality rather than the time element Both types strive to do the best possible work under the conditions imposed

A few statistics may provide some index to the volume and type of work turned out by the two kinds of finishers Mr Pavelle places the yearly average of film rolls processed at his plant at about 150,000, while Mr Derfler's place develops about 250,000 annually At Pavelle's, 75 percent of the film is in the 35mm class, while at Royaltone all but a small percentage are the usual amateur sizes other than 35mm The latter averages 2,500,000 prints a year, 80 percent of the total printing business being contact, 20 percent enlarging At Pavelle's, the greater percentage of the printing business calls for enlargements, a good portion of the orders being for postcard size en-

largements from 35mm negatives. A visit to the Royaltone plant was an eye-opener, in view of the stories we have been hearing about those awful "drug store" finishers The 90gallon temperature-controlled film developing tanks are continually being replenished to keep the solution top-notch, the tank is completely refilled every 16,000 rolls Rinsing is done in a tank through which fresh water is running continuously. Fixing is done in two successive baths, the first a strong bath, which is thrown away and a new bath made every 4000 rolls, and the second a weaker hypo bath, which is changed every 12,000 rolls Finally, the film goes through two washes Drying is done in special rooms equipped with fans to circulate heated air Printing s not the slapdash affair many persons have been led to believe it is. Each printing machine operator has before him a selection of six different grades of contact paper, from which he selects the proper grade to fit individual negatives Also, timing is not the same for all negatives but is proportionate to the density of individual negatives When the print reaches the developed stage it is inspected by the operator there, who may reject a print which has been printed for an insufficient period or on the wrong grade of paper It is then sent back to the printer for a better print In other words, the photo-finisher of the Royaltone class

worker would do in his own darkroom at home Maintaining standards of the highest order, the Pavelle plant offers a universal service, making prints ranging from contact to photomural dimensions That the quality of its

does just about what the careful



Leo S. Pavelle inspecting an exhibiting print in the making

work and the universality of its services has been recognized is shown by the fact that monot Pavelle's patrons are departmented. Favelle's patrons are departmented by the fact and of the fact and the

One of the Pavelle plant's major activities is the preparation of enlargements intended for exhibition Department was created, in which from 100 to 200 exhibition prints a week



Large trays facilitate handling of prints for exhibition purposes

are turned out, most of them 11" by 14", a good percentage 14" by 17" Mr Pavelle observes that there is a definite trend toward the latter size as the more popular among exhibitors The prints are mounted on the regulation 16" by 20" matts required by salons A wide variety of papers and surfaces are available in this department to match every good negative to the paper best suited to bring out the values and mood of the negative. Most of these prints are selenium or gold-toned Mr Pavelle says that the resulting tone is almost imperceptible but is enough to show a real difference, one of the valued results being the realization of better blacks

One of the features of the Pavelle plant that helps in maintaining quality of service is the Research Group, a skilled staff which has at its disposal complete photographic laboratory testing equipment for testing ever-changing new developments in photography.

"As soon as anything new appears on the market that may be utilized photographically, be it a new light source, a new film, a new paper, or a new developer, it is immediately put through an accurate laboratory as well as practical test." Mr. Pavelle says. "Nothing is taken for granted. If the product proves of merit, its properties are carefully evaluated to the processes used throughout the taboratories. One outstanding not example of the work accomplished is the compilation of complete sensitometric data for all 35mm films and all popular developers."

The Pavelle plant is the last word in modern high-grade equipment, all developing being done in stainlesssteel tanks and all machines automatically controlled to process different types of film for the exact times of development, fixetion, and washing as well as at a definite rate of agitation in each solution required for each film type "Ours is perhaps the only still-film laboratory in the daily sensitometric tests determine with scientific accuracy the activity of negative developing solutions Our negative developers are kept at a constant developing potential by the addition of replenishing solutions in definite ratio dependent on the number of square feet of film that have been developed. Thus all films are invariably developed to a specific gamma in a given period of

Paper in Quantity

THE worker who takes advantage The worker who takes advantage of economies in order to keep his photographic costs down, may be interested in the fact that the purchase of printing or enlarging paper in half gross or gross lots will effect a considerable saving Of course, if only a few prints are made occasionally or if the worker likes to do a lot of experimenting with different papers, this may not be appealing. But those who have settled down to one paper and who do much printing will find that they can save as much as 20 percent or more by purchasing paper in gross lots rather than in packages of a dozen

Cooling

A summertime developing kink that may possibly be out of date by the time this appears in print (though it frequently happens that temperature runs rather high during some days even in the "cold" seasons of the year) comes to us by way of the picnic basket. A product known as Icit, a sealed can measuring about four by six by one inches and containing a liquid, is being sold for use in cooling the picnic lunch. The can is placed in the lowest ice-cube compartment of the refrigerator the night before the picnic The next day it is frozen solid and is placed in the center of the picnic lunch The use of Icit in photography is obvious The can is placed in the developer tray and, according to the experience of Carlyle Trevelyan, will bring the temperature down to 65 degrees Fah-



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Fifth Annual Scientific American

AMATERR PHOTOCRAPHY CONTEST

[For Camplete Contest Rules, See Page 94, August 1940 Scientific American]

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N this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPE-CIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners.

These special awards will be given in addition to the regular prizes that the pictures win

DIVISIONS IN WHICH PRINTS MAY BE ENTERED.

Division 1 Human interest, including camera studies of people. animals, and so on. Portraits will be grouped in this division Division 2 Landscapes, including all scenic views, seascapes, and

so on. Division 3 Action, including all types of photographs in which action is the predominating feature

THE PRIZES

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1st. Three \$125 LONGINES, Corona- 4th. Three FEDERAL No. 345 tion Model. Solid Gold. Men's Wrist Photo Enlargers (List Price \$42.50).

2nd, Three \$85 LONGINES, Presentation Model, Solid Gold, Men's \$19,75).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price

Wrist Watches

oping tanks.

6th. Three BERMAN-MEYERS Flash 3rd. Three FEDERAL No. 246 Guns complete with case (List Photo Enlargers (List Price \$49.50). price \$15).

7th. Three FINK-ROSELIEVE Vaporators (List price \$12.50)

HONORABLE MENTION

3rd. Three Raygram Wood-Chrome

lst. Three Fink-Roselieve "Hi-Spot" 4th. Three Fink-Roselieve Audible Hollywood type spotlights.

Timers 2nd, Three Mimosa Perkino devel- 5th, Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS I

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price \$24.) 2nd. One No. 650 Weston Exposure Meter (List price \$19.95.)
3rd. One No. 850 Weston Exposure Meter (List price \$15.50.)

THE JUDGES.

McClelland Barclay, artist T J Maloney, editor of U. S Camera Ivan Dmitri, artist and photographer Robert Yarnall Richie, photographer Address all Entries to

Photograph Contest Editor, Scientific American 24 West 40th Street New York, N. Y.

CAMERA ANGLES...

renheit. Mr. Trevelyan says that when he used the method one night. he placed the can in the tray at 7 o'clock, when the temperature fell to 65 degrees, and by 12 o'clock the temperature had risen only six degrees. Naturally, the can has to be taken out of the tray when prints are inserted, but this is a negligible inconvenience considering the vantages

General Electric Contest

EXCELLENT handling of a much photographed subject—the 129-foot stainless-steel symbolic lightning bolt and universe in front of the General Electric Building at the New York World's Fair-brought prize for George Perry, of New York City, in the first half of the General



First prize, G. E. contest

Electric contest. The award was \$100 in cash. A similar prize is offered in the second half of the contest for entries received until October 11

Held under the auspices of the Photographic Society of America, the judges consisted of Adolf Fassbender, FR.P.S, Chairman; Robert Brown, Morris Germain, A R P S., Carlyle Trevelvan: and Jacob Deschin, ARPS

Color Handbook

"HANDBOOK OF COLOR," containing A a complete description of every type and make of color camera, lighting, equipment, chemical, printer, righting, equipment, chemical, printer, color film, and so on, will be published by Fotoshop, Inc., in the near future. Copies, at 25 cents each. may be reserved by writing to the Color Department of Fotoshop, Inc., 18 East 42nd Street, New York City The contents will also include laboratory instructions for all color processes, technical data on film, filters, and so on; a basic course in the fundamental principles of color photography, and a book-review supplement. The book will contain fourcolor illustrations. It will have a moisture-proof cover and spiral

binding, the contents will be crossindexed with manila separators for ready reference

The Rhyming Publicist

If prose seems inadequate to the task of singing the excellence of one's ware, try poetry, thinks Eleanor F. Brown, of Burke & James, Inc. So once in a while we receive from her such a missile as

"Any day is washday

For the fellow making prints

So here's a brand new washer

That will give the world's best rinse!"

Then she goes on in prose to give particulars concerning the Luxor Water Powered Tank

Another time, snappy, readable prose describing the Watson 35mm camera is preceded by this lilting introduction

"For a candid with color correction,
Other features that really are slick!
Let the Watson be your next selec-

tion
It's priced so your purse cannot but"

Under Water

A TRICK by which contact printing can be done without drying the negative, is used, we understand, by some old-timers when the necessity for seeing the result speedily is more important than print quality or permanency Glass plates are used After the plate has been fixed and washed, it is placed in clear water A sheet of contact paper is then immersed in the water and placed in contact with the emulsion side of the Firm contact is assured by carefully squeegeeing the water out with the fingers. Printing is done by an over-head light We are told that by this method, washing of the print being very brief, the result of a developed plate may be seen on paper within two and one-half minutes

Living Title

A CLEVER photographic idea for a magazine cover was recently reproduced on the cover of the magazine Vogue. A model in a batting suit who was obviously expert at gymnastics was photographed in five poess, each of the word Vogue. The five pictures, taken and reproduced in color, appeared at the top in the usual place for the magazine name. The main illustration on the cover was a repetition of the V pose except that the in the magazine name little in the magazine name itself her face was in three-quarter pose.

Darkroom Wiseguys

EVERY camera club probably has one, maybe more. The other day we heard of a chap who was developing some enlargements for perhaps

the first or second time. At any rate, he did not know anything about it After focusing the image on the easel. he gave an exposure of a few seconds, purely from guess (a guess based on total ignorance because guessers may often justify their practice on the basis of long experience) and developed the print for one half minute, after which he pulled it out of the developer and slapped it into the fixing bath When someone suggested that it might be a good idea to make a test strip first to determine the required exposure time and furthermore that a half-minute developing time was not sufficient to provide a decent black with the paper he was using, he replied "Maybe it isn't, but that's the way I like to do it." Perfectly silly reply, of course, and we are happy to report that this particular worker has now learned the error of his ways and is beginning to mend them Those of his type who do not are best discouraged from continuing in the game altogether

Boys' Clubs Contest

Pinst prize in the National Historical Photographic Contest held by the Boys' Clubs of America at the New York World's Fair, was awarded recently to Francis Hoesch, 14 years old, Boys' Club of Baltimore, Maryland The picture, "Fort MeHeny" (the American flag flying there during an attack by the British in 1814.



"Fort McHenry"

was the inspiration for Francis Scott Key's "Star Spangled Banner"), is reproduced here The prize was an all-expense-paid trip to the New York World's Fair, with a stay of one week, and a complete photographic outfit

First Camera in America

DENTIFICATION of the first camera in America and the first "fast action" camera in the world appears to have been made at long last.



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according to an Associated Press dispatch from Hampden Sydney, Vir-The old box-shaped camera left at Hampden Sydney College in 1839 by Dr John William Draper antedates even the one used by Dr Draper at New York University to make the first portrait of a living per-The Smithsonian Institution con has accented the camera as the first and will install it among its exhibits

It took eight years of research by the Rev Howard C Cobbs, formerly a professional photographer, to provide the necessary proof Mr Cobbs found final proof in a letter by Dr. Draper addressed to The Photographic and Fine Art Journal, published in 1858. In that letter he told of working with sensitive plates before Daguerre's and Talbot's announcements, and of experimenting with a large aperture. short focus lens However, he related that the "first portrait" was made with the help of Daguerre's more sensitive plates and methods

WHAT'S NEW

In Photographic Equipment

NEW KODAK 35 (\$47 50) With coupled lange-finder and Kodak Anastigmat Special lens f/3 5 in Kodamatic shutter Range finder of split-field military type, in which two halves of large image are lined up as lens is focused Focusing range 4 feet to infinity Focusing by means of control wheel Lens mount and type Shutter settings for time, bulb, 1/25th, 1/50th, 1/100th, 1/10th 1/200th, plus delayed action Advancing film automatically winds shutter and brings into view small red signal indicating all is ready for next exposure View finder of optical eyelevel type, built into range-finder housing Slight shift brings eye from range-finder eyepiece to view-finder eveniece

RAYGRAM PHOTO COLOR KIT (\$1 25) New medium for coloring photographs, transparencies, and lantern slides, devised in laboratories of Joseph Dixon Crucible Co Enables coloring all positive photographic materials without preliminary sizing or final fixing of colors. Claim Layman, not trained in art of coloring, with little practice, can neatly and easily do work heretofore attempted only by professional. Kit includes eight colors and shades

Solar Triple Sliding Lens Board (\$475): Attaches to all models of Solar enlargers except Junior, replacing standard lens board Slides easily back and forth, permitting instant placement of any lens in optical center of enlarger. Measures 91/4 by 23/4 inches Sliding member takes three lenses, allows %-inch clearance at back Board accommodates lenses up to 71/4 inches focal length. Diameter

of threaded opening on three lens flanges 1½ inches (38mm) Reduc-ing flanges available at extra cost.

F-R STAINLESS STEEL THERMOMETER (\$1) Made of 18-8 stainless steel. Dark blue spirit in glass column shows distinctly against etched calibrations to give accurate readings Scale registers from 40 to 90 degrees, Fahrenheit. Special clip offers wide use with travs and tanks

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the Amateur Photographer

Q Can you suggest a method of making glass diffusers?-C. J. K. A You can make your own glass diffuser by obtaining plain glass squares and scratching parallel lines with a glass cutter. Use a ruler as a guide. The closer the lines are to each other, the greater the diffusing effect obtained You might cut one glass with lines 'm of an inch apart. and another with lines 14 of an inch apart If you wish to use only one glass, space the lines is of an inch and expose through it for only part of the total exposure time

Q I would like to know what kind of developer and the process to use to make a negative print from a nega-

tive film .- E. H. T. A. This is known as the Paper Negative Process A contact or entive in the usual way, and the paper print is placed in contact, emulsion to emulsion, with another sheet of print paper. Exposure is made through the back of the positive print just as if it were an ordinary negative A positive print from the paper negative may then be made by placing the paper negative in contact with another sheet of paper Processing and developer are the same as usual. Single-weight paper should be used, although the final positive or negative, whichever is the final result you want to achieve, may be printed on double-weight paper if desired.

2. I would like to make black and white prints from some of my Koda-chrome transparencies. Will you ex-plain the procedure?—R. D. B.

A Make a negative by contact or enlargement, the latter method being preferable because you can then use a colored filter to emphasize or repress certain colors. Slow panchromatic film should be used. The process is



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similar to that employed in making ordinary prints. However, the film is much faster and the proper safelight should be used, namely, the green, preferably no light at all. The final paper print is then made in the usual way.

Q. I am using a twin-lens reflex and find that in attempting architectural shots in which it is impossible to photograph from a distance, much vertical distortion occurs. I have wondered whether anyone has devised the use of a prism in front of the lens to correct this condition, the device possibly installed on a vertical axis in a filter mounting.—E. P. G.

A We have not heard of any such device and doubt its usefulness. Cameras of the miniature type are designed for general photographic purposes and are made small and compact for convenience, the resulting negatives usually being enlarged When architectural shots are attempted, the camera is tilted up, correction of the consequent vertical distortion being done under the enlarger by tilting the easel on which the paper lies in the direction opposite to the tilt in the negative Enlargers are now also available that have a tilting negative holder, which facilitates this

Q Can you recommend a fine quality sensitizing material which can be applied to glass so as to get a good print?-E. C.

A The glass is first coated with the

following solution Gelatin . 42 grains

Potassium bromide 26

Distilled water 1 ounce The gelatin is first allowed to swell in the ounce of water for a full hour. The temperature may then be raised gradually until the gelatin is thor-oughly dissolved. While the solution is still warm, add the bromide. In a separate dish, prepare a bath of 32 grains of silver nitrate and one ounce of distilled water In the darkroom, by red light, slowly add the silver nitrate solution to the bromide gelatin solution This mixture is then ripened by heat (100 degrees Fahrenheit) for one hour The emulsion is poured into a glass beaker, the latter then being placed in a 110-degree water bath Stir frequently and when ripening is complete, add slowly two or three times as much gelatin as was used originally. When this added gelatin has dissolved, place the beaker in cold running water until the emulsion jells, when it is cut into squares with a toothpick The pieces are then tied up in a cloth bag and suspended in running water to wash for two hours. All this is done in the absence of white light When the washing is complete, the emulsion may be remelted for coating Pour a pool of the warm emulsion in the center of the glass and spread it into the corners with a glass rod bent L shape. When dry, expose, develop in D-72 diluted 1 to 4, and fix and wash as usual.

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A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

or Springfield type mountings for reflecting telescopes, in contradistinction to the real McKay, which is the straight Springfield originated by R W Porter, described in the instruction book "Amateur Telescope Making" and revised by him in its sequel, "Amateur Telescope Making—Ada Maki



Figure 1. Phillips mounting

vanced," there are no end, each different and each ingenious. The one in Figure 1 was made by Robert Phillips, 3448 Greenview Ave. Chicago. Ill He says the mounting was made from two Buick front wheel as-semblies welded together at right angles with struts and cemented into a 5" pipe Setting circles are marked on the rims of the brake drums and, these being 36" in circumference, it was easy to mark off the divisions, 1/4" equalling 21/2" in dec and 10 minutes in R A The tube is made of 1/2" maple dowel stock on rings of plywood-too light according to standards, Phillips says, but he adds that he had no trouble with it Total cost of telescope was \$25

Another ingenious version of the Springfield type is that in Figure 2, an 8" with Micarta tube and an external framework of structural alumnium angle—a kind of exoskelution Carl Oman, 433 Springdale Avenue, East Orange, N J, is the maker

When, once before, as above, we called something the real McKay, somebody wrote in to say that the correct expression was "the real McCoy," referring to the late boxing man, Kid McCoy That, however, is a corruption—one that, in fact, is not the real McKay—of the correct expression. That expression had repression that the pression of the pression of

LATS are preferred by many, instead of prisms, as diagonals in reflecting telescopes in the following note Cyril G Wates, 7718 Jasper Ave. Edmonton, Alta, Canada, discusses the subject pointedly

"When the amateur has completed a really fine parabolic mirror, and has finished gloating over the beautiful optical 'doughnut' which the Foucault test reveals, he finds himself faced with the problem of diverting the reflected rays through the side of his telescope tube into the

Figure 2: Oman's mounting

eyepiece Shall he use a right-angled prism, or shall he use an alumnized diagonal? I faul to find that sufficient emphasis has been land upon the relative ments of prism and diagonal, either in these columns or in the pages of 'ATM' and 'ATMA' Perhaps there is a tendency among TNs to regard the two as optically equivalent, but this is far from being the carbon being the carbon

"Taking the diagonal first, it has one outstanding advantage Any diagonal mirror, no matter how much its surface may deviate from a plane, is absolutely achromatic Suitable diagonals with surfaces correct to

one quarter wavelength are not too difficult to make, or may be purchased quite reasonably in the smaller sizes. This degree of accuracy is sufficient to insure realization of the fine to insure realization of the fine-qualities of a good objective, accord-ing to H H. Selby and others ('ATMA,' p. 131). In the days of silvered surfaces, amateurs were justified in fighting shy of diagonals, but modern methods of aluminizing remove all objections to these little mirrors Those who make their own diagonals may hear in mind as I have pointed out in this department (September, 1938), that for long-focus mirrors the difference between a circular diagonal and a 'correct' ellipse, is purely academic The light cut off by the unused part of a circular diagonal is infinitesimal

Turning to prisms, there is one bit of advice which should be burned into the brain of every aspiring amateur avoid inferior prisms as you would the plaque A diagonal mirror has only one place at which it can display defects, the surface The prism has three angles and three surfaces While it is as easy (and as difficult) to figure the diagonal surface of a prism to the required standard, this perfection will be largely nullified if any of the angles are incorrect, or either of the other surfaces imperfect A right-angled prism with an accurate diagonal face, but with the other surfaces irregular and the angles incorrect, is exactly equivalent to a bit of cheap plate glass interposed between the eyepiece and the objective. Lack of parallelism between the faces of such a piece of glass would cause color fringes, and irregular surfaces would result in distortion and bad definition

"Even a perfect prism or a perfect 'plane-parallel' (the two are optically equivalent) causes color dispersion, an effect which, according to Pierce, is quite visible even with a focal ratio of 1/8. This dispersion, which



Figure 3: Pope's Springfield

-TELESCOPTICS-

appears as a faint fringe around such objects as the Moon and Venus, is unavoidable, but is so unobjectionable that the smateur need have no hesitancy in using a prism, provided it is a good one. Reputable dealers will, of course, supply just what is ordered. and it is unreasonable to expect a Grade A prism for the price of a discard. A fine prism is necessarily more expensive than an equally good diagonal, for the reasons already



Figure 4: Pope and observatory

stated For short-focus mirrors such as the RFT, it might be wise to decide upon a diagonal and avoid any possibility of color fringes, which are much more objectionable with a wide cone of rays

"What is the standard by which a prism should be judged? First, all surfaces should be correct to a quarter wavelength Second, the angles should be accurate within not more than 3 minutes of arc (Martin) The familiar 'split image' test ('ATM,' p 54) may be made extremely accurate, espe-cially if a circular diaphragm or washer is used between the eye and the prism (Pierce), but this guarantees the correctness of the right-angle only, it is perfectly compatible with gross errors in the other angles. If you are in doubt, go to the physics department of the nearest university and get them to measure the angles for you

"A word with regard to collimation of a prism. The prism mounting must be adjustable in all directions Pushpull screws are hard to beat, combined, of course, with a rod sliding in the boss of the spider Eliason's method of reflection from the eyepiece face of the prism is excellent ('ATMA.' p 272), but does not go far enough The eyepiece face may be at right angles to the optical axis of the adapter tube, yet the mirror face (of the prism) may be hopelessly out of adjustment.

"It is advisable, therefore, to extend Eliason's adjustment by some such method as that shown in Figure 5. which has worked out well in practice. A disk of cardboard is attached to the mirror end of the tube In the exact center of the disk is a hole (at least 4,", to avoid diffraction), with two heavy black lines drawn two heavy black lines drawn diagonally through the hole, as shown.

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The disk is illuminated by means of a flashlight, the end of the tube being covered by a black cloth.

"The prism is first adjusted to the eyepiece adapter by Eliason's method it is then further adjusted by watching the reflection of the diagonal lines and eyehole, in the mirror face of the prism When this adjustment is correct, the push-pull screws must not be altered again. If the prism no longer responds to Eliason's test, it

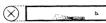


Figure 5. Suggested by Wates

must be corrected (1) by sliding the prism mounting in its collar, (2) by rotating the prism, (3) by altering the alinement of the eyeptece adapter If this method is pursued, both square faces of the prism will be exactly at right angles to the axes of both tubes

"If, after the prism is squared up as described, the mirror is not centered as seen through the adapter tube, the prism is probably bad, and Porter's method for warped mirrors would be tried (LTML'), 2.84

should be troud of ATM, p of 10s should be troud of ATM, p of 10s of 10s

Wates calls for prisms flat within a quarter wavelength and with angles within better than 3 minutes of arc from perfect ("pyramidal error 3'," the professional would term this) Just how good is this, compared with the prisms amateurs have been buying? Definite data are not available on the quality of all the prisms sold to amateurs in the past but here are some criteria The Perkin-Elmer Corporation, professionals, rate prisms as follows A-quality-precision, 1/8 wave or better and 5" pyr. error, or better A-quality, 1/8 to 1/4 wave and 1' pyr. error or better. B-quality, 1/4 to 1/2 wave and 5' or better. C-quality, 1 wave and 10' or better Thus, the prism Wates asks for is, after all, nothing especially superlative, falling in Class B and costing, for a prism with one-inch-square face, between \$3 and \$5. How many, if any, Class D, E, F, G . X, Y, Z prisms have amateurs purchased in past years?

Your scribe recalls his first telescope, which had a prism picked up free because it was a reject You could have thrown a cat through the gap between its face and a try-square, yet the telescope provided a big thrill, at least for a little while, even if the prism did make of it almost a spectroscope At that time, 1928, the smateur.

telescope making hobby was a cub with burrs in its hair. Porter's statement. in "ATM," page 54, written also at about that time, that "the right angle of the prism need not be exactly 90° for our purpose," didn't seem and then wasn't much out of place. It is literally true today—within the tolerance quoted by Wates from Martin. but the language will be altered in future reprintings. Also by this test a prism could have a perfect right angle. yet the other angles might be, say, 44° and 46° respectively, without the tester being the wiser. Pierce claims that, with the prism held at 30", the split image test is good to 34 seconds of arc If made with a small telescope this accuracy would be correspondingly multiplied, he points out

Wates next continues with the description of a diagonal support of his design

"The 'classic' method of adjusting the diagonal by means of one or more slots in the tube is not only poor mechanical construction, but also has the serious objection that, when the screws are moved in the slots, the diagonal is swung away from the optical center of the tube My earlier design, which appeared in the October, 1935, number, is satisfactory for a prism, but is too bulky for an ellip-tical diagonal mirror. The design shown in Figure 6 has been used in an RFT and can be adapted for any size telescope Because of the spherical surface between A and B, the diagonal moves as though pivoted on the optical center, thus greatly simplifying adjustment

"The diagonal is mounted in a brass tube, as described by Hindle in ATMA,' except that the space between the glass and the plate A is packed loosely with coarse steel wool. The top surface of A is turned to a



spherical surface with radius τ , which sould be measured with a caliper, but may be more accurately determined by the use of the equation

$$r = 1 \quad h' + hd + \frac{d'}{2}$$

"The method of attaching the four vanes E to part B is shown in Detail 1. The slots in B are cut carefully with a fine hacksaw Note that the slots are slightly off-center. Half an inch of the ends of each vane is softened and tinned. One eighth inch is folded over, to fit into the holes in B, which



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-TELESCOPTICS-

is then heated and the holes filled with solder. The tube of my RFT being sheet aluminum, the wrought iron ring F was used for stiffening.

"D is a spring steel washer, shown in Detail 2. The diagonal and its mounting can be moved in any direction without changing the position of its optical center and, when correct. the screw is driven home.

"In turning the three disks, A, B, and C, templates, both concave and convex, should be cut; one pair to radius τ and the other to radius τ plus the thickness of B. After turning to correct curve, the various surfaces may be ground together with fine Carborundum

"To forestall the criticism that there is no provision for longitudinal adjustment I will say that, although such adjustment can be provided, it is quite unnecessary If the spider ring is accurately mounted on the tube, the center of the diagonal will be in line with the center of the eyepiece tube If not, the ring can be moved until it is correct, and then permanently fixed

N the May number of The Journal In the May number of the British Astronomical Association, F J Hargreaves describes his pet polishing lap-wax on pitch, as follows "The wax-on-pitch polisher consists of an under-layer of pitch supporting wax facets on a netting foundation. The wax does not yield or flow under pressure, and therefore the grooves between the facets do not fill up in use, as with polishers of pitch only The pitch under-layer, however, can yield or flow to allow the wax facets to make contact uniformly with the surface being polished This under-layer can therefore be made as soft or as hard as desired, according to circumstances, leaving the wax-polishing layer unaffected." Grim are the circumstances under which this is reported in summer, from a meeting on the banks of the Thames

FROM S L Walkden, father of the RFT or Richest-Field Telescope, who lives in London, came, in the midst of the liveliest bombardment. a long letter about telescoptics and not a syllable about the war except to say that, London being permanently blacked out, he found with rejoicing that he could see fully three magnitudes of stars that previously were invisible, and with his own RFT he had found some thrilling Milky views

Your scribe lives in a New Jersey suburb on a corner surrounded by eight street lamps and bathed by three flood-lamps from a filling station, and the only time he ever even sees the Milky Way is when out of town

IN CASE you are planning to use the King test ("ATMA," p. 269) and have intended to use the sugar and water solution suggested, don't; it won't work Other liquids—oils— have been substituted Write in and ask, if especially interested.

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Preparedness

RECENT amendment to the patent Alaws is intended to rethrore the preparedness program. The amendment grants to the Commissioner of Patents the right to withhold the publication and granting of a patent for such period or periods of time as in so opinion the national interest requires, where the publication of the invention would be detrimental to the public safety or defense. In this way inventions dealing with ordinance, bombs, or other military or, naval weapons may be kept secret so as to prevent them from falling into the hands of foreign agents

Heretofore many important inventions of this character were patented Upon the issuance of the patents the inventions were published and were available for reference. The withholding of a patent might possibly work a hardship upon an inventor since he can only collect profits and damages for infringements occurring subsequent to the granting of the patent In order to protect the inventor the amendment to the law also contains the provision that an applicant whose patent is withheld by the Commissioner shall tender his invention to government and thereafter he shall have the right to sue for compensation in the Court of Claims, the compensation to begin from the date of use of the invention by the government Thus it will be seen that the inventor can recover, from the government, compensation for the use of his invention occurring even prior to the granting of the patent

Caruso

COMPETENC manufacturers of food products were involved in a controversy over the right to register as a trade mark the name of the famous tenor. Enrico Caruso. The original user of the name Caruso had registered it in the United States Patent Office in 1918 as a trade mark for macaroni and similar food products. The other manufacturer registered the name as a trade mark for canned tomatoes and tomato paste in 1923. Subsequently the original user brought proceedings to cancel the later trade-mark registration of the other manufacturer.

It was argued by the second registrant that he had the right to maintain his registration because he had received permission from Mr. Caruso to use his name and picture in connections.

tion with his food products. The Patent Office and Court of Customs and Patent Appeals found that both registrants had received permission from Mr. Caruso to use his name and picture. It was held, however, that this per se was not controlling. The right to register a trade mark is controlled by the federal statutes relating to this subject and a person may not register a trade mark which is likely to cause confusion in trade. It was held that the registration of the name Caruso by the second registrant was likely to cause confusion with the trade mark of the first registrant and accordingly it was ordered to be canhallan

Superman

A CARTOON strip relating to a ficti-tious character of superhuman strength identified as Wonderman was held to be an infringement of a copyright relating to a cartoon relating to a superhuman character identifled as Superman Fach character was represented as being the strongest man in the world, as being the champion of the oppressed and as battling against evil and injustice. Each was represented as performing similar feats of superhuman strength such as crushing a gun in his hands and as catching the bullets or shells from a gun and throwing them back to the place whence they emanated. It was contended by the infringer that the copyright was invalid because the cartoon character Superman was merely a comic Hercules This argu-ment was rejected by the Court for the reason that an original production or creation, however poor in quality, is entitled to copyright protection.

In this connection, the Court stated: "But if the author of 'Superman' has portrayed a comic Hercules, yet if his production involves more than the presentation of a general type, he may copyright it and say of it: 'A poor thing but mine own.'

Ascop

NEMBERS A Statute which would have destroyed or seriously handicapped an organization through which a large number of authors, composers, and publishers of musical compositions receive substantial income for the production of their compositions was recently declared unconstitutional by a Federal Court. This statute declared it to be unlawful for authors, composers, and publishers to form any society, association, or

-LEGAL HIGH-LIGHTS-

similar combination wherein the members constituted a substantial portion of the authors, composers, and publishers within the United States and when at least one of the objects of the combination was the determination, and fixation of license fees

mination and fixation of license rees.

The statute provided further that thereafter all license fees fixed by such a combination were null and void and that authors, composers and proposers of the copies of their musical composition the license fees charged for private and public renditions of the composition. Upon payment of the specified fee the purchaser of the composition ould use or render the composition without any further obligation without any further obligation.

The statute also provided that if the author, composer, or publisher falled to specify a license fee on printed copies of the composition then any purchaser thereof was free to use and render it without the payment of any license fee whatsoever

The American Society of Composers, Authors, and Publishers, an association of approximately one thousand composers and of 123 publishers, commonly known as Ascap, brought suit against the Secretary of State of Nebraska to enjoin the enforcement of the statute on the grounds that the statute was unconstitutional. The Court held that the provision of the statute requiring the owner of a copyrighted musical composition to offer it for sale in a certain manner, 1 e, by specifying a license fee on printed copies of the composition and the provision depriving him of any compensation if he fails to offer the composition for sale in the manner specified was in violation of the Federal Constitution and also of the Federal Copyright Act in that it denied the copyright proprietor due process of law

Bacteria

THE lowly bacteria which has been accused of causing many of the human woes and illnesses has now been deprived of the benefits of our patent law

The patent law provides in part that anyone who has invented or discovered any new variety of plant which can be assually reproduced is entitled to receive a patent. Under this section of the law an attempt was made to obtain a patent on a new form of bacteria. The Patent Office rejected the application for the patent on the grounds that a bacteria was not a plant within the meaning of the patent law.

An appeal was taken to the Court of Customs and Patent Appeals and the court ruled that while scientifically a bacteria was a plant, Congress intended that the word "plant, Congress intended that the word "plant, Sondould be given its popular meaning and this did not include bacteria. The Court accordingly sustained the Patent Office in refusing to grant a patent for bacteria.

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PLASTICO ROK SERVICE BULLETIN is a pamphlet showing a wide variety of uses for the mending and patching plastic material which was described on page 222 of the April 1940 issue of Scientific American. Technical Supply Co, Palo Alto, California—Gratis

THE DENSITOMETER AND ITS USE IN Color Printing is a manual published for use with the Marshall Densitometer However, it offers valuable information to all interested in making color prints. Text and illustrations are non-technical. The manual covers, in comprehensive form, such important points as. instructions outlining the general requirements of good color prints, how to make accurately balanced separation negatives, how to use gray scales, general use of densitometers in color work. how to check separation negatives. etc Included are time-gamma charts, filter factors, etc Gratis to purchasers of Marshall Densitometer; 25 cents to others Albert Specialty Co. 231 South Green St., Chicago, Illinois

RESEARCH LOOKS TO NEW HORIZONS IS a 32-page booklet, illustrated in colors, showing the progress of research and industry from early horizons to the present day. Specific examples show the starting results that have been obtained by research incligently applied Department of Corpora Relations, General Motors, October Office of Parties of P

Tenite is a 28-page booklet that describes this plastic material and illustrates many of its uses in a wide range of industries. The book is of particular interest to manufacturers, molders and designers. Please request it on your business letterhead. Tennessee Eastman Corporation, Kingsport, Tennessee - Gratis.

DU PORT'S PARTNESSETF WITH THE FARMER IS A BOOKlet Which shows clearly that both products for the farm and those made from farm products have been made a valiable-farm through chemical research. The booklet also shows how many farm products, after processing, go back to the farm either for direct use or as aids in the preservation and marketing of other farm products. Agricultural News Letter, E. I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware—Craite

THE WORKING OF S. A. E. NICKEL AL-LOY STREES is a 16-page pamphlet of data compiled from the practice of 34 leading fabricators. It covers effects of heat treatment, and gives practical instructions for machining, grinding, welding, and gas cutting. The International Nickel Company, Inc., 67 Wall Street, New York, N. Y.—Gratts.

"Ham Gume" was written specifically to tell the radio amateur how to to RCA transmitting tubes to best advantage. It also includes constructional articles, giving complete details for the state of the

A NATIONAL TRANSPORTATION POLICY, by Senator Clyde M Reed, is a 14page booklet that outlines the problems of transportation in the United States and presents facts aimed toward their solution Association of American Railroads, Transportation Bldg, Washington, D C.—Gratis.

ALPHA SYSTEM OF BRIDGE DESION is a 28-page illustrated booklet that describes a system of steel and removed control of the system of steel and removed control of the system of the system of the system of removed concrete with much that this system combines the rigidity of removed concrete with much system of the system of

PLASTRIC AND FINISHING GUIDEBOOK COMPRISES 188 pages of practical information in the plating and first nign industries, plus 70 pages of advertising and "quick-mailing coupon service" for readers. The text consists of a series of articles covering all phases of plating and finishing. The Metal Industry Publishing Co., Inc., 116 John St., New York City —

G-E HOME WIRING HANDROOK IS a 24page pamplet that is essentially a guide for planning electrical wiring for homes I to utilines wiring requirements and specifications, shows how to determine the adequacy of wiring, and gives a chart of residential outlet requirements General Electric Company, Bridgeport, Connecticut.— Gratis.

CUT STEEL PROFITABLY WITH KENNA-METAL TOOLS AND BLANKB IS A 6page folder describing this tool alloy. It includes tables of comparative physical properties and recommended speeds for machining steels of various hardnesses. Illustrations show typical turning, milling, and shaping operations. Bulletin 740. McKenna. Metals Co., 341 Lloyd Ave., Latrobe, Pa.—Grafts if requested on business letterhead.

C. P. CHEMICALS AND ACIDS is a 158-page catalog of "Baker's Analyzed" laboratory and technical chemicals. J. T. Baker Chemical Company, Philippburg, New Jersey.—Gratis.

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HORTONSPHEROIDS in a modern refinery in the West Indies are the interesting objects shown on our front cover. These have a capacity of 20,000 barrels each and are used to store gasoline under two and one half pounds pressure to reduce excessive evaporation losses.

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SCIENTIA OMNIA VINCIT

NYLON, it was said in these pages last month, probably will not cut deeply into the Japanese silk industry for five to ten years. When and if it does, that will be the Japanese farmer's worry, what disturbs some cotton men is the expanding use of rayon Indeed, to that fiber is attributed a sizeable part of the problem now facing American cotton farmers

Rayon production has increased nearly a thousand percent since 1924, says the Industrial Bulletin of Arthur D. Little, Inc. Yet, reports that circular, it was not until 1938 that rayon consumption exceeded that of secured wool and became a poor second to that of cotton. And if rayon consumption doubles in the next decade, it will still total a third of current cotton excessionables.

Growers of the natural fiber, nevertheless, may not rest content. That one third is the equivalent of several million bales of cotton. Already an increasing production of cotton abroad is cutting into our exports, may cut far more heavily as the years pass. And with rayon taking a larger share of the home market's cash, it seems appropriate that the American cotton farmer take stock of the situation and readjust his economy in time to meet and weather the storm. Assuredly, rayon is going to be used more widely in rugs, tires, many fabrics that now commonly use cotton, and, in "staple fiber" form, as a mixer with cotton fibers in cloths traditionally made of cotton.

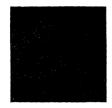
There is one bright light on this dark horizon. Down in North Carolina, there have been under way for years experiments in turning the whole cotton plant—stalk, leaves, boll, and fiber—into rayon. The plants are mowed down, oil is extracted from the seeds in this bunch of sticks and fiber by use of solvents, and the remaining celluloisic material is made into rayon. Years ago, this process was a laboratory success. If and when it is made commercially practicable, it will save our trees—which now go into rayon—will take up surplus cotton stocks, and will sidestep that part of cotton production which is more costly than all others combined the picking job.

For decades, the cotton grower has been roundly scolded for concentrating stubbornly on his one crop Still, he sticks to it. Perhaps he cannot interpret the handwriting on the wall, "Science conquers all," as saying that science replaces the old with the new. If he doesn't now make a determined effort to understand, he may soon be complaining of technological displacement—F D. M

DEFEND YOURSELF OR DISARM

The right of the American citizen to bear arms, secured by the Constitution of the United States, has definitely been abridged by local and state laws, but has never—yet—been completely rescinded That "yet" is important If certain fanatical anti-firearms groups were permitted to have their way, every sporting arm in this country might have to be registered and its owner duly "mugged" and fingerprinted. Or, even worse, such firearms might be subject to confiscation or to storage in some public place when not in actual use.

Every sportsman who uses firearms-whether he



"plinks" with a 22, is a devotee of skeet or trap, or likes to punch holes in paper targets with rifle or pistol—should be aware of the dangers that threaten his sport Anti-firearms fanatus formerly used the erime-prevention pretext for proposed legislation. Now they have a new one National defense! They would keep weapons out of the hands of fifth columnists by taking them away from everyone! And just as does the thug and crook, the fifth columnist will hide his firearms where they are readily available, while the lawabiding cittzen complies with the rules and leaves himself unarmed! The theory is beautiful, but it does not work out in practice

In this same vein, Ellinge F Warner, well-known sportsman and publisher of Field and Stream, holds up Switzerland as an example of a free nation where anti-firearm agitators would never be happy. "For many months," says Mr. Warner, "little Switzerland has been surrounded on all sides by warring nations, but up to today she has not felt the tramp of hostile armies. When aw replane crosses the Swiss border, the Swiss open fire. She is small, but she is mighty. Rumors have been current that armies would march across Swiss soil, yet up to date Switzerland is the only country in the theater of war that has not been ridden over roughshod

"The ctuzens of that courageous republic," continues Mr Wanner, "don't keep their guns in public armories. At all times the citizen of Switzerland has a military rife within reach, and he knows how to use it. Every young man is an army graduate. When he has completed his military training, he takes his government rifle or hand-gun home with him. And each year thereafter he is allotted a certain amount of ammunition and required to shoot this ammunition in order that he may keep familiar with firearms and know what a good rifle and a good pistol or revolver can do Even the most ready anti-firearm crank must admit that Switzerland would be an unhealthy place for hostile parachule troops to land."

We cannot help recalling that this vast nation of ours was virtually built by men whose very lives and livelihoods depended on their skill with firearms. True, the march of civilization has changed this piecture materially, but it can never change the love that millions of American men hold for firearms and their use. It rests in the hands of these same men—you and 1—to preserve for all of us the right to own and use rifles, hand guns, and shot-guns in the pursuit of sport and recreation. Make use of our democratic processes by letting your legislators know now that you, together with millions of others, want no interference with your rights in this matter. Write Telegraph Make yourself heard in the halls of Congress

National defense by disarming the citizens! By the Red Gods, what a travesty!—O D M

50 Years Ago in . . .



(Condensed From Issues of November, 1890)

CANAL—Recent cable advices report that work is being energetically pushed on the Nicaragua Canal. An aqueduct twelve miles long, to bring pure water from the mountain streams, is being laid Offices, hospitals, and quarters for employes of the company, adequate to the present needs, have been receted Several millions of feet of lumber have been received from Atlantic and Gulf ports, and cargoes are continually arriving

LIGHT COST—Incandescent electric lamps are lessening in cost of manufacture while, at the same time, increasing in efficiency, that is to say in length of life Now, with improvements in exhausting apparatus, it costs but a tithe of the old figure to produce a more perfect vacuum, the sealing of the platinum wires is done by machinery, and as a result af ar more certain and a longer-lived lamp than that which once cost \$1\$ may be had for considerably less than the half of it

WAR TRENDS—The conditions under which the next armed conflict between powerful countries must take place are of an altogether different character from those known heretofore; but in such future contest, come when it may, it is safe to say that science and skill; rather than brute force, will have a determining influence to an extent never before known in the annais of war

HORSE MEAT—Just twenty-four years ago the first horse butcher in Paris opened his shop. Since then there have been started nearly 140 horse flesh shops in the department of the Seine, and at the present time about 20,00 horses are killed every year in Paris for human food in Paris the price of the meat is less than half that of ordinary butcher's meat Berlin is following the example of Paris

LUMBER—In 1880 the 25,708 saw mills then in operation converted \$120,000,000 worth of raw timber stock into various kinds of lumber, at the same rate there would be no good-sized timber left in forty years

EFFICIENCY—Another path in which the American iron works can now develop is in that of reducing wastes of fuel and of material. Now that mechanical engineering has developed machinery for handling to such an extent that the smallest possible amount of manual labor is required, the engineers might be allowed to take a rest in steam boilers and enginees and furnaces, with a view to saving fuel

COLUMBUS—In the confusion of new and old times, and of different years. It is far from easy to determine be exact anniversary of Columbia' first sight of our shores. Four hundred years ago many discrepancies existed in the times of celebration of Christmas, and there is even a possibility that the year should be 149 or 1498.

STREET LIGHTS—One of the companies in Paris that deal in compressed air for motive power has been awared the contract for street lighting on a novel plan. The company distributes power through its condensed air system to an immense number of small dynamos, each of which turnishes current for a small number of lamps TORNADOES—A special investigation of the subject of tornadose has been carried on by Prof. H. A. Hazen, of the Government Signal Service, during the past year It appears that in no State may a destructive tornado be expected oftener, on an average, than once in two years, and that the area over which the total destruction can be expected is exceedingly small.

UNDERGROUND—Among the new works lately inaugurated in London is an underground electric railway known as the City and South London Railway, 3½ miles in length The road-bed consists of two tracks 4 feet 8¼ inches in width, which are laid in two underground tunnels, each 10½ feet diameter. There are four stations



One of the peculiarities of the work is its great depth underground, the ralle being, with few exceptions, not less than 40 feet below the streets, while in some places they are 100 feet underground. At the stations the two tunnels are brought into an enlarged chamber built underground, and from these passengers are raised by elevators to the street level. The cars are propelled by electric committees are able to make a speed of 25 miles an hour, but the trip of 3½ miles, making four stops, is made at the rate of 15 miles an hour.

GROWTH—In Demmark and Sweden it has been the custom for many years to welfs and measure the school children every year. Out of 15,000 boys and 3,000 girls the results were as follows. In the seventh or eighth year of high life boys grow considerably in height and in weight, after which a delay sets in which reaches its maximum in the tenth year and lasts till the fourteenth year, when a considerable acceleration of growth suddenly sets in.

INSULATION. There is great need of improvements in insulating material An insulation for wires is needed that will be cheap, light, fexible, and durable; one that dampness will not decay, nor the heat of an electric arc dissolve or burn

PAPER PIPES—Gas pipes from paper are made from strips of mania paper equal in width to the length of the pipe to be made, which is passed through a vessel with melled asphalt, and then wrapped firmly and uniformly around an iron core until the required thickness is attained. The pipe is then subjected to powerful pressure. . These pipes are claimed to be perfectly gas tight ... and very resisting to shocks and concussions.

SCIENTIFIC AMERICAN · NOVEMBER 1940

OUR PART IN NATIONAL DEFENSE

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TELEPHONE SYSTEM — READY TO SERVE

THE UNITED STATES IN NORMAL TIMES

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Walter S. Gifford, President, American Telephone and Telegraph Company

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Water & Expand





TO CORRECT WIDESPREAD MISCONCEPTIONS— During a five-year test, F. H. Frankland, Chef Enginer of the American Institute of Steel Construction, observed that in a wind of 80 miles per hour the Empire State Building in the City of New York took a temporary lean of about 2% inches, and then swayed across that lean at the rate of 7.85 times per minute through an eight-inch arc. Thus, at one end of each sway the building reached 6% inches out of plumb away from the wind, and at the other end returned to 1% unch beyond plumb toward the

REFRIGERATOR MILEAGE—The compressor motor of an electric refringerator travels the equivalent of 2500 on miles in five years' normal operation—enough to carry it around the world 10 times if t could travel under its or power.—Notes, Westinghouse Electric & Manufacturing Company

A TRAIN EVERY FIVE SECONDS—Approximately 18,000 passenger trains and about 15,200 freight trains operate daily over the tracks of the American railroads. On
this basis, a passenger train starts on its run somewhere
in the United States every 45 seconds, and a freight train
starts on its run every 57 seconds, day and night, on the
average.—Association of American Railroads.

MOTH LARVAE CRAWL IN—Experiments prove that a flying moth will lay her eggs in the crack of a chest or closet and the larvae when hatched will have no trouble crawling into the container if the opening is about the thickness of newsprint paper. Sealing with gummed tape is recommended—Wallace Colman, United States Bureau of Entomology and Plant Quarantine.

CHEESE MINES—Much Roquefort type cheese, which requires to ripen an atmosphere nearly saturated with water and varying but slightly from 48 degrees. Fahrenheit, is being made in quantities in this country—in caves along the Mississippl near St. Paul, in rooms into which control to the state of the state

MOTES—Research engineers have measured more than 100,000,000 dirt particles in a single cubic foot of air in one particularly dirty city—Notes, Westinghouse Electric & Manufacturing Company

WAR EXPORTS—For war supplies, Japan has depended primarily on seven countries headed by the United States. In percentages, imports of such supplies from these countries were as follows: United States, 55.7, British Malaya, 8.7, Canada, 8.5, Netherlands Indies, 8.3, Germany, 4.3, British India, 3.3, Italy, 1.3—Dr. T. Y. Hu, Chinese Council for Economic Research

COLONIC IRRIGATION—It is extremely difficult to determine the field of usefulness, if any, of colonic irrigation While the role of the small cleansing enema and of the medicated retention enems seems well established, colonic lavage has been outrageously exploited in many quarters. There is little evidence to show that it may benefit disease the colonic properties of the colonic properties of the colonic properties. It is other hand, it may cause harm—The Journal of the American Medical Association, August 3, 1940, page 404

COLDER ICE—Ice men in Bangor, Mame, have found that their crystal-clear natural ice, frozen at. —20 degree. Fahrenheit, lasts longer than artificial ice frozen at 15 degrees. The ice is used extensively in air-conditional Pullman cars between Bangor and Boston—Taylor Rochester, Summer Edition, 1940

YARN—Some cotton yarn is so fine that 50 miles of it are needed to make one pound. This yarn is spun on ordinary textile machinery to make typewriter ribbons, airplane fabrics, and fine dress goods—R. J. Cheatham, U. S. Department of Agriculture.

ROSE INDUSTRY—More than one half of the world's supply of rose-bushes, or 20,00,000 per year, are now grown commercially in Texas. They are of 16,000 varieties. The industry, mainly in eastern Texas, ships rose bushes to every state and to 25 foreign countries.—Notes, American Petroleum Institute.

COMMON PIMPLES—Among Eskimos, native black Africans, Australian aborigines, and Maoris, acne vulgaris appears to be a much less common disorder than it is among civilized white people. As the Maoris adopt modern methods of living, the condition occurs more frequently—The Journal of the American Medical Association, August 17, 1940, p 55

AIR CONDITIONING—Schools of air conditioning and refrigeration attract students with glowing promises of work in an uncrowded field, fail to give proper training, and much bitter disappointment is the result.—Refrigerating Engineering.

SCIENCE FRUSTRATED, PERVERTED—The function of science is to untile the whole human family, whereas the function of politics seems to be, both in the case of the human family and of each nation, to create parties and to emphasize them as much as possible.—Nature, August 3, 1940

MILK WINE—Either sherry or sauterne type wine can be made from milk whey. So far, however, only seven bottles of milk wine have been made. It has an alcoholic content of 15 percent by volume.—Notes, National Dairy Products Corporation.

EFFECT OF SCIENCE—The chances of a new-born child reaching age 65 are today as great as the chances of reaching 50 were only 30 years ago.—Dr. Louis I Dublin, Metropolitan Life Insurance Company.

TOOL ALLOY—Important to our national defense program, the steel-cutting tool material, Carboloy, was produced in July in a quantity four times that of July 1939. Also exceeded was the previous peak month of June 1940—Notes, Carboloy Company, Inc.

WIDOWS—Every year about 400,000 wives in the United States become widows. The average age of widows at the death of their husbands is somewhat less than 55 years, and practically one quarter of them—that is, about 100— —are at ages under 45 —Statistical Bulletin, Metropolitan Lite Insurance Company, August, 1940.

Personalities in Industry

six years old he admired a six years old he admired a new two-wheeled "break-cart" on his father's horse farm in West Virginia Here, he saw, was a vehicle getting along with half as many wheels as usual. Why, this youngster thought, couldn't you go one step farther and have a one-wheeled cart? He labored and whittled and finally produced a one-wheeled cart, but it turned out to be only a wheelbarrow. He was disappointed, but he had taken his first step in a career of invention.

Mason is not the wild-eyed, long-haired type of genius Now, as vice-president in charge of research of Masonite Corporation—a huge concern that sprang from his own research—he is intensely human and exceedingly modest Rather than talk about himself, Mason, if you will let him, will invariably swing the conversation around to one of his pet subjects. The late Thomas Alva Edison, with whom he was associated for 17 verses.

Much of Mason's youth was spent breaking and training trotting and gaited horses. After several years at Washington & Lee, he transferred to Cornell to study mechanical engineering When the Spanish-American war broke out he left college to become a naval engineer.

After a shoe factory job, Mason went to work as a draftsman in planning Edison's new cement plant at New Village, New Jersen Mason was retained by Edison to help supervise actual construction of the plant, and later became building superintendent of all of Edison's various enterprises.

In 1916 Mr. Mason again pulled up stakes to serve his country. He was given charge of all construction for the U. S. Merchant Shubulding Corp., at Bristol, New Jersey. Later he went South to go into the business of extracting naval stores from sawn lumber, in which he employed a process of his



WILLIAM H. MASON

own. He made his headquarters at Laurel, Mississippi.

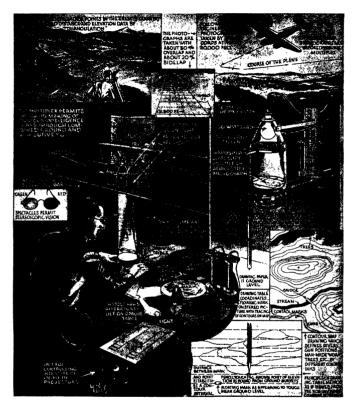
Mr Mason watched with interest and concern the large proportion of a tree that was utter waste in the saw mills—redgings, slabs boards of unmarketable shape or size. Here, he thought, was a vast supply of valuable raw material going to waste. If some economical means of reducing those scraps to fiber could be found, it would be a blessing to the paper industry

Mr Mason found a way. He boses of deep sold in way. He boses of deep sold to form of the fact. In the hole he placed clean wood chips and a little water, and then plugged up the end. He heated the cylinder with blow torches until about 800 pounds of steam pressure was generated inade. Then he suddenly released the plug There was a roar, and the air was filled with a shower of wood file.

The fiber was too tough and strong to make a good grade of paper. Besides, the lignin—nature's binding cement—that coated

the fiber would make the paper harsh. Instead of trying to eliminate the lignin, Mr. Mason turned it to advantage. Under heat and pressure he made the damp fiber mass into dense, smooth boards that could be used in hundreds of ways that its parent material, wood, could not, and that could withstand punishment which would destroy wood. The lignin, instead of being a drawback, served to hold the fibers together Mason had, using nature's own materials, improved on nature. His "Presdwood" had no grain, it would not splinter, would not warp, and it had a high resistance to moisture A new industry was born. Mississippi farmers had a new crop. Before long they were cultivating second-growth pine, heretofore of little value

While the above article on the activities of Mr. Mason was being prepared for printing, word was received of his sudden and untimely death.—The Educg.



RELIEF MAPS FROM AERIAL PHOTOGRAPHS

Before guns can be trained on an enemy, that enemy must be put on a spot and that spot must be on a map—a map that shows elevations as well as linear distances Accordingly, U S Army engineers are employing a method of producing relief or topographic maps from stereo photographs made by the Air Corps Essentials of the system employed are shown above. Although it is impossible to survey enemy territory from the

ground, preliminary control points may be established by the usual methods. Then stereo photographs are taken from the air and, reduced to proper size, projected in the Multiplex instrument shown. Now, by means of accurate controls, the operator adjusts the floating mark so that it appears to rest on a certain level of the stereoscopic image. Then, by guiding the instrument over the drawing table so that the floating mark appears to follow points of the same altitude, the pencil attached will trace a contour line. The floating mark is then adjusted to another level, in predetermined scale, and the process repeated. The finished drawing will form a topographic map.

Chemical Factories at Home, Plantations in Brazil

WILLIAM B. LANDIS

As the unsettled course of world attention on the problems of national preparedness, the question of obtaining adequate supplies of commodities and materials essential to American national defense as under frequent discussion

One of the most important of these materials is rubber, about 80 percent of which comes from British and Dutch possessions in the East Indies. The possibility that this rubber supply will be cut off, or at least curtailed in future years, looms as a serious threat, particularly if the rubber colonies should be seized by one of the totalitarisan powers. In many circles it is believed that such a situation would have serious consequences, particularly in regard to its effect upon our national defense program.

However, the picture appears less dark for the immediate future when studied in the light of other facts Stocks of crude rubber on hand and afloat are sufficient to meet the nation's normal requirements for nearly six months, and efforts are being made to increase this supply still further For example, crude rubber now in transit to United States ports is approximately double the amount in transit a year ago. But in spite of these accelerated shipments, it is now too late to obtain reserve supplies of crude rubber sufficient to meet our needs, if the supply from the East Indies should suddenly be cut off.

A study of the situation reveals two possible solutions to the problem. The first is rapid development of artificial or synthetic rubber. The second is to establish supply sources closer to home.

Of these two courses, mass production of "synthetic rubber" has the greatest immediate possibilities While real tonnage production of synthetic rubber is lacking at present, and prices are consequently somewhat higher than for natural rubber, producers of the chemical product are of the opinion



that they can swing into large scale production within six to eight months, should the necessity arise

Although no definite predictions can be made regarding price, it is thought that chemical rubber can eventually be produced at a cost that will bring it within the price range of natural rubber This opinion is based on the low cost of raw material from which chemical rubber is made, together with the fact that mass production methods might reasonably be expected to lower the now expensive processing costs.

ALEADY factory-made rubber is serving a variety of useful purposes, especially in the automobile and aviation industries. In many cases it is not only proving a most desirable substitute for the natural product, particularly in places where resistance to oil and heat is required, but it is also replacing leather and other materials to a large extent

large extent
In tensile strength, vibration resistance, and other physical properities, most chemical rubbers compare favorably with the natural
product. Most varieties can be
worked on existing equipment in
American rubber factories and can
be vulcanized or processed at the
same speed as natural rubber.

To conserve the nation's supply

of natural tubber, consumption of that product can be reduced by approximately one half, a prominently, if the natural rubber in tire treads and sidewalls alone is replaced with a recently developed chemical rubber Research in that direction undoubtedly will bring out still further means of conserving the nation's natural rubbes supply, either by outright substitution of factory rubber for the natural, or by combining the natural and artificial products

Obviously, any extensive use or large scale production of chemical rubber in this country within the next few months would necessarily have to be accomplished under pressure, as an emergency measure Many authorities agree that from a long-range standpoint, the development of chemical rubber should go hand in hand with establishment of a source of natural rubber in the Western Hemisphere Thus the threat that rubber shipments from the East Indies may be cut off has at least served to make America realize that something must be done quickly, if no pinch is to result from the possible curtailment of the main source of sup-

That something was already being done long before foreign events took their present disastrous course is evident from the advancements made in developing chemical rub-

bers Progress has also been made toward establishing a source of crude rubber supply in the Western Hemisphere, particularly in Brazil The Ford Motor Company has a \$20,000,000 project, consisting of two plantations, under way there on land along the Tapajoz River, a major tributary of the Amazon.

This program, launched on a



In rubber-tree bud-grafting, a bud from s "clone," or family, with desirable characteristics, is the state of the state of

by means of which thoroughbred

At the Brazilian rubber plantations, it is expected to increase the yield of the native jungle trees by crossing with East Indian trees and also by scientific planting and cultivation For the present, the estimated yield is set at 1000 pounds per acre, although subsequent developments may change that figure.

Although many problems have been encountered in developing the estates, operations are well under way at Belterra and Fordlandia—the company's two planta—tions located 24 and 110 miles respectively up the Tapajoz from its confluence with the Amazon. Concessions upon which these planta—tions are located embrace a total area of more than 2,000,000 acres. At Belterra, where it is expected

that rubber will be produced commercially in rather substantial quantities by 1941 or 1942, more than 12,000 acres have been cleared and planted with approximately 2,675.000 rubber trees These are almost entirely budgrafted with high yielding clones from Sumatra, Java, and Ceylon. In rubber terminology it should be explained, a "clone" is a rubber "family" of definite, known characteristics which have been propa-



more or less tentative basis in 1928. and expanded to its present proportions in 1934, is scheduled for completion in 1950 It is expected to produce an average of 1000 pounds of rubber to the acre, or 76,000,000 pounds annually Whether or not the project can be completed by the scheduled time depends upon a number of factors, chief of which is the problem of obtaining sufficient native help. In some circles it is believed that the necessary labor might be obtained through the co-operation of the Brazilian government, particularly since a number of Brazilian leaders are urging that country to do everything possible to regain at least a measure of the supremacy it once enjoyed as a rubber producer

In that connection, it is interesting to note that the Ford rubber estates, operated under concessions from the State of Para, are located close to the spot from which Henry Wychham, an English adventurer, smuggled 70,000 seeds of rubber trees of all varieties, 78 years ago planted in the famous Kew Gardens at London, these seeds produced 19,000 healthy seedlings which were taken to the East Indies and used in founding the great rubber plantations there. For his part in this, Wyckham was knighted

Descendants of these very trees now have been brought back to Brazil to strengthen the native stocks and develop high yielding varieties. These East Indian plantation varieties, which are expected to rehabilitate the jungle varieties and make them suitable for plantation growing, are the very finest that have been developed in the Far East. They represent the fruits of an intensive program of propagation and cross-pollination which British and Dutch interests have carried on for years, to develop rubber trees with high yield and other desirable characteristics

As a result of this research, rubber trees have been developed in the East Indies with yields running as high as 2400 pounds to the acre Incidentally, in the rubber industry an "acre" means 100 trees, without regard to the area concerned.

When one compares the high yield of the East Indian trees with the 300-pounds-per-acre average yield of jungle rubber, one wonders why such a difference exists, especially when present-day East Indian varieties and native Brazilian trees are descended from the same stock Dotannist attribute this to selective propagation, a process similar to stock breeding methods similar to stock breeding methods



gated by the process of crossing.
At the Fordlandia plantation,
where 6500 acres have been
cleared, activities are given almost
entirely to experimental work and
research. Here the Ford Motor
Company has planted one million
trees and is conducting all kinds
of experiments to produce a highyielding Brazilian clone that will
be immune to South American leaf
disease and will possess other desirable qualities

Test tappings are being taken primarily to determine what characteristics the trees are developing, but rubber thus obtained is being shipped in latex form to the Ford plant in Dearborn, where it is used in making tire fabric. In addition to developing various creaming agents to facilitate shipment of ialex with a high dry rubber content, the company is also experimenting with smoked sheets, in which form a large part of the world's cruder jubber is shipped.

It might be mentioned in passing that many experts regard Brazilian rubber as the finest in the world. Although the native Brazilian trees have a lower yield than their cousins from the Far East, the rubber they produce is unsurpassed in quality and is used largely in the manufacture of surgical supplies.

To combine the high quality of the native Brazilian trees with the high yield and good health of the East Indian varieties is perhaps the main purpose of the research now being done on the Ford plantations

Crossing these varieties is accomplished in two ways by cross-pollination and by bud-grafting Cross-pollination produces asen that will reproduce the dominant characteristics of the two parent trees Bud-grafting, on the other hand, may be used to speed the processes of multiplication and also to give one tree the desirable characteristics of several others.

Inasmuch as cross-pollination and bud-grafting play a prominent role in rubber tree propagation, a biref outline of the natural process involved might not be amiss. Before they are "crossed" by insects, two trees must be in bloom at the same time. All male blossoms are stripped from one tree, and all female blossoms from the other Bees are then placed in a cheese cloth sack, over the male flowers (from, which they gather pollen) and are later transferred to the trees from which the male flowers



In tapping a rubber tree, a special knife is used to make a cut, two feet from the ground, on a 30-degree angle along half the circumference. Care is taken not to cut into the cambium layer. A spout at the lower end of cut directs into a small cup the latex which flows from the bark

have been removed. Crossing by artificial means is successful approximately 7 to 9 percent of the time, while when bees are used as outlined, 20 to 25 percent successful results are obtained After pollination, the blossoms developm to seed pods, each seed containing certain definite characteristics of the two parent trees.

Bud-grafting is done about a year after seeds are planted Bud-patches are cut in the seedling trees three to four inches above the ground, and a bud cut from bud-wood of high yielding clones is inserted in the bud-patch of the seedling. The patch is then turned to its original position, enclosing the bud, and taped in place with a waxed bandage.

Twenty-one days after budding.

the bandage is removed in order to see whether the bud is alive If it is, the bark that covered the bud and which still adheres to the lower part, is cut off Seven days later the budded rubber trees are again inspected If the buds have continued well, the rubber trees that were used as stock are cut off one and one-half inches above the bud. at an angle of 45 degrees so that rain water will not accumulate After this, the budded rubber trees are inspected monthly Shoots that naturally appear in the cut-back trees are pruned Trees that die are replaced

Each acre of land thus planted contains 220 rubber trees When these trees reach the age of five years, a yield proof is taken That is, they are tapped to determine the amount of dry rubber they yield Low yielding trees are eliminated and the number of rubber trees is reduced from 220 to 100 to 150 per

Maintenance of the rubber properties is itself a major problem. After the rubber trees are developed, a leguminous plant of rapid growth and high reastance is planted, 100 holes per acre, and in a short time covers the entire planted area. This is done to check the development of weeds and also to aid in maintaining the humidity of the soil.

For the operation of its rubber plantations at Belterra and Ford-landia the Ford company is now employing about 500 men On these plantations, the company has 917 buildings, all designed to suit the various purposes for which they are intended. Good light and water facilities are provided

Six sechools are maintained with 13 teachers giving instruction to 498 children of both sexes. Hospital is services are excellent, there being two hospitals with a capacity of more than 120 beds, both with X-ray and ultra-violet ray equipment laboratories, pharmacies, excellent operating rooms, plumbing and saintary facilities, and also completely equipped dental offices. Whale Mr. Ford's primary object in setting up his Brazilian rubber plantiations was to establish in the Western Hemisphere a source for a large part of the rubber consumed annually by his company, the research and experimental work that has been carried on might well prove of great value to Brazil, if rubber production on a high scientific plantiation basis is to re-olace the more or less habbargard

The Brazilian government and commercial associations are now aware that the country must have good technical men if the rubber wealth of the Amazon valley is to be developed properly Undoubtedly, the experience which Ford has gained during the past few years will prove helpful, and cooperation between these agencies should help eventually to re-establish Brazil as an important source of the world's crude rubber supply

tappings of native jungle trees

Pending such developments, the United States must continue to depend chiefly on supplies of natural rubber from the Far East, at least until sufficient quantities to meet our needs can be obtained from South American tappings and our own chemical rubber production

superior quality as well as speed of service made possible by the newer chemicals that has caused the prodigious growth of the drycleaning industry to 12,000 plants and 200,000 retail outlets.

Until very recent years, a garment returned from the drycleaner's advertised itself by its distinctive odor. In those days, petroleum distillates such as benzene and naphtha were commonly used, replacing gasoline which was used in still earlier days About 1929, chlorinated hydrocarbons were adopted for wide use. The use of one of these, carbon tetrachloride, required expensive equipment, however, so further research was necessary According to M Marean, writing in the Du Pont Magazine, equipment costs were reduced by a product called trichlorethylene which was first employed in 1931. Two years later the Du Pont Company made it available especially for dry-cleaning purposes This preparation is now used by cleaners in 40 states and in the District of Columbia. Another product, perchlorethylene, was later developed to meet the specific operating needs of certain systems



Rings left by the "spotting" process are removed by spray

When you send your soiled garments to a cleaning establishment that uses these modern fluids, you can count on the sure removal of spots made by oils, fats, greases, waxes, tars, and many other substances that commonly stain fabrics Another advantage of these solvents is that they work rapidly, requiring a minimum of mechanical action, thus saving much wear and tear on clothes. Colors become brighter, and materials regain their original feel and luster. The fluids do not cause shrinkage; silks and woolens retain their shape. As an

Dry-Cleaning Grows Up

Chemistry Stimulates Growth of the Business

Into a Great Nation-Wide Industry

MMERCIAL dry-cleaning has, within the past two decodes, entered the ranks of high business there of the ranks of high business dry-cleaning processes, together with lowered prices made possible by these improvements, have raised the amount of cleaning done by 40 or 50 times in the past 20 years, and the amount spent for it from \$55,000,000 to more than \$600,000.

New synthetic solvents have wrought great changes in the business Non-flammable and non-ness Non-flammable and non-ness non-flammable and non-ness non-flammable and non-nest possible to the property of the



A garment is measured before the cleaning, and it must go through the process without any shrinking or stretching or alteration of original shape

At the right, a quitted house-cost and severs! dresses are being loaded into a machine for cleaning in the modern manner with synthetic fixed. The process does an odoriess job in far less time than was possible formerly. Below: Because rames are important, an evening frock is hand-pressed after being thoroughly cleaned after being thoroughly cleaned.





extra precaution, all garments are carefully measured, before and after cleaning, to avoid any pos-

sibility of a change in shape. After the main cleaning, up-to-date establishments carefully scrutinize all garments to see if any spots remain, for no known dry-cleaning fluid will take out all stains. Water-soluble stains, such as ugars, fruit juices, and certain pigments, usually require after-treatment, but they are easily removed by special fluids, as the general process does not set them. Then everything is thoroughly aired, and carefully pressed.

When one realizes the tremendous number of articles produced in materials that may be drycleaned, the benefits of quality service are more fully appreciated According to estimates, some 550,-000,000 men's suits go to the cleaners in a year, an average of a suit a month for 45,000,000 American men and boys. Women patronize the cleaner's facilities only slightly less, probably sending 40,000,000 agarments a year to be dry-cleaned Millions of window curtains, costume accessories, and upholstery covers are also included

With the increasing adoption of modern methods and equipment, cleaning establishments are able to give all these garments thoroughly satisfactory attention, not only assuring their return in spotless, odorless condition and good shape, but preserving the strength of the materials through quick and careful handling

BANANA FIBER

Hemp Substitute From

Skins of the Fruit

THE Formosa Development Co, a Japanese organization, reportedly has succeeded in producing a hemp substitute from banana skins The concern plans to install 500 sets of a special fiber-extracting machine with which it hopes to produce 4,000,000 pounds of the substitute annually

TEMPERATURE PILLS

For Production Control

in Wide Heat Range

N some metal-working industries it is next to impossible to work out a temperature control of production, especially in the black heat range A new method, so simple that it can be entrusted to unskilled labor, has been developed by the Tempil Corporation of New York The method involves use of small wafers somewhat like enlarged pills, different types of which melt at different temperatures One of these, stamped plainly with its melting temperature, is placed on the surface of the metal, the temperature of which is to be controlled to an exact point. When the pellet melts, that temperature has been reached

Tempils, as these pellets are called, are safe to use and are not corrosive to any metals. They do not pit or leave objectionable stains which cannot be easily removed They are available in even hundred-degree ranges from 200 to 1500 degrees. Fahrenheit

Tempils are being used to prevent cracks in metal processing, to make stronger and safer welds; to indicate the approach of safe temperature limits in the manufacture of costly castings, forgings and machine equipment, for checking thermocouples; and for many other purposes where accurate heat control is essential

CUTTING TOOLS

Standardized, Lowered

In Price

Newspapers recently gave the impression that, because of some real or fancied hook-up with German firms, production of Carboloy in this country would not Carboloy and the country would be worst bottle-necks (how that word has been worn threadbare!) in our defense program Recent communications from Carboloy Company, Inc, indicate that Carboloy tools are not only available in numbers but have been standardized for faster production and much lower prices

Carboloy cutting tools, as now standardized, are designed to cover 80 to 90 percent of all applications for cemented carbide tools The simplified line comprises five styles in three different grades. They will be carried in stock ready for shipment, completely ground and ready for use-including even the grinding-in of chip breakers on tools designed for machining steel. Mass production economies will most likely decrease the amount of brazing and grinding done by organizations who at present purchase Carboloy tips to make their own tools

A typical new standard tool costs only \$1.85, as compared with a previous cost of about \$5.84 in lots of one. In quantities of 50 or more, the tools now cost only 90 cents

BACTERICIDAL

Water, Milk, Beer May Be U-V Rayed

CONSIDERABLE research has been carried on in recent years in an effort to use ultra-violet rays to kill bacteria in water, milk, fruit juices, beer, and other liquids, and there



Experimental furnace used in the development of "Endogas"

is now some promise that these efforts may be successful, according to Dr H. C Rentschler, Westinghouse research engineer

nouse research engineer
Ultra-violet rays are already
successfully destroying harmful
bacteria and other microscopic organisms in hospitals, industrial
plants, food shops, and many other
places

"Water used for pre-cooling vegetables prior to shipment," Dr. Rentschler revealed, "has been irradiated and the bacterial count reduced by 80 percent or more Tests have shown, however, that milk and fruit juices allow only slight penetration of the radiations, hence must be treated in thin films in order to achieve material reduction in bacterial count. Beer has been found to be practically opaque to such rays.

"Seven years of intensive research involving huge expenditures, have indicated that the use of ultra-violet radiation in the field of assepsis is likely to be the nucleus of a new branch of electrical industry, open a new chapter in the field of illuminating engineering, and prove to be of inestimable value in the field of public health and industry in general"

GAS BLANKET

Prevents Burning and Carbon Loss in Steel Hardening

A NEW gas blanket protects the "skin" of high-grade steel parts against heat-burn during the hard-ening process, according to J R Gier, Westinghouse research en-

gineer. Such fine steel products as gears, springs, bearings, and metalcutting tools would benefit from the new gas, which has been named "Endogas"

The gas mixture answers the demand by steel manufacturers for an inexpensive atmosphere that one will prevent scaling and softening of steel surfaces under heat treatment between 1500 and 2300 degrees. Fahrenheit Loss of vital carbon from the steel can be prevented by the balancing effect of carbon in the new gas.

"Endogas" is made by mixing aur with natural gas, or other mexpensive fuel gas, and heating them to 1850 degrees in an electrically heated chamber By regulating the amount of gas and air entering the chamber, it was found, the proper amount of carbon could be sent along to the furnace to balance the amount of carbon in any grade of steel

"OILED" SILK

Synthetic Rubber Used On Silk, Rayon

ANNOUNCEMENT of a new fabric of innumerable uses, waterproofed with a coating of a synthetic substitute for rubber which has most of the natural product's advantages without its disadvantages, has been made by the Goodyear Tire & Rubber Company Pluosheen is the name of the new fabric.

Phosheen fabrics, either of silk or rayon, are waterproof, odorless, tasteless, flame-resistant, contain no rubber or oil. The fabrics may be produced in the complete range of delicate pastel colors, deep tones, or clear white, all of which are sunresistant and proof against cracking or peeling.

Lightweight Pilosheen fabrics are sheer and soft, but extremely strong and durable. They combine high soil-resistance with a facility for easy cleaning—a damp cloth being adequate for removal of most common stains. Phosheen fabrics may be printed without technical difficulties, making possible an unlimited array of patterns designed to harmonize or contrast with surroundings of any specific application.

MILLING MACHINE

Univertical Bench Type With Swivel Head

A MILLING machine with a swivel head, graduated to a range of 90 degrees either way of the perpendicular, that can take over all the small jobs or about 90 per cent of the work that has to be normally done by machines costing five times as much, is announced by J. D Duffy & Son The Univertical high speed end milling machine is modern in every respect and capable of the most exacting precision work It is rugged, compact, powerful, it mills, drills, and bores Univertical mills an 8 by 16 die at one setting, and is designed for the use of cutting tools up to % of an inch. It can also be adapted to small grinding operations

A bench type machine with a base eleven by seventeen inches,



Swivel-head milling machine

it is powered by a heavy duty \(\frac{1}{4} \), the horsepower motor, has a four-horsepower motor, has a four-speed V-belt pulley, permitting a range of from \$50 to 3400 revolutions per minute, handling a broad latitude of intricate milling. Its overall height is 37 inches. The maximum lift of the table to the end of the spindle is 10 inches with a work clearance of 8½ inches from the center of the spindle to the supporting column.

STERILIZATION

Process Sterilizes Animal Fibers Without Damage

A NEW process for sterilizing animal fibers and killing any disease organisms on them without damaging the fibers has been patented by three research workers of the United States Department of Agriculture. The new process will afford protection from such fiberborne diseases as anthrax It will also be of particular value in preventing the spread of contagious disease. The process can be used in hospitals, laundries, and dry-cleaning establishments for sterilizing blankets, clothing, and other articles that may come in contact with disease germs

It works equally well with woven or raw fibers and with synthetic fibers made from proteins, such as the new fabric made from milk. The process cleans, disinfects, and sterilizes without injuring the keratin which is the basis of all the animal fibers. It is an improvement on current methods in the dry-cleaning industry and makes use of Stoddard solvent, a petroleum distillate of low flammability used in dry cleaning. In the new process the solvent is heated.

The newly patented process is adaptable for removing oils and fats from raw wools and permits degreasing and sterilization in one operation

GRINDER

Grinds Locomotive Pins

In Place

The problem of refinishing locomotive crank pins has been greatly reduced in time and expense by the Milwaukee Portable Locomotive Crank Pin Grinder, a product of Goetz-Voss Corporation The Aluminum News-Letter says that this grinder is mounted directly on the



Grinding a locomotive crank pin without disassembling

crank pin, and does a precision job without the delay of disassembling the drivers and putting the pin in a

The grinder consists of a lightweight aluminum frame on which are mounted two grinding wheels and the necessary precision controls to resurface the pin without damage

IODINE SHORTAGE

Germany Feels the

Pinch of the Blockade

A considerable shortage of iodine has developed in Germany owing to curtailed imports caused by the blockade, and various measures have been adopted to restrict consumption and maintain supplies to meet indispensable requirements.

Germany is dependent upon foreign sources for all of its odne requirements Net imports expanded markedly in 1935, in consequence of a special trade agreement with Chile, to 228,500 kilograms from 57,600 in 1934. Subsequent to 1935, however, imports contracted steadily, falling to 128,800 kilograms in 1938, and 107,500 in the first seven months of 1939.

Residues, solutions, and other iodine-containing industrial wastes of the pharmaceutical industry plants producing inorganic or organic iodine-containing preparations, and especially the photographic chemical industry, are considered most prolific and advantageous sources for the recovery of iodine. In the case o many waste and residue materials, recovery of 80 or 99 percent is possible. Such recovery might be uneconomic in normal peace times, but costs now are subordinated to the imperative need of stretching existing supplies

PUNCTURE-PROOF

Inner Tube for

Combat Vehicle Tires

ONE thing that puzzles the layman in viewing pictures of vehicles used in warfare, is the question of why their tires are not more often punctured The answer is that the usual type of pneumatic tire is often punctured in service by bullets Indeed, armies of the world have endeavored to find some way of gaining the advantage of such non-solid tires and at the same time preventing their destruction by enemy fire One of the ways of doing this is to make a sponge rubber tire This. however, has a number of disadvantages.

A new Bullet-Seal inner tube has been developed for the tires of war vehicles by the Seiberling Rubber Company. This tube has a double thickness of small cells filled with a plastic gum and lining the usual tube wall. The cellular structure prevents the plastic from being thrown to the outer periphery of the tire, keeps it evenly distributed throughout the inner tube When a bullet penetrates the tire, the kneading action of the tire rolling over the ground kneads the plastic into the hole made by the bullet and effectively seals it Tires so equipped are said to have withstood successfully a burst of shots from 30-caliber and 50-caliber machine guns.

GERMICIDAL PAINT

Antiseptic and germicidal paints have long been sought by researchers Foster D Snell recently stated that the use of oils to which chlorine or iodine have been added produces a paint which will kill the germ of typhoid fever and some others for nine weeks after painting, and shows some but not complete killing power after six years

FIRE WALL

Millions of "Fire-Walls"

In Insulation

MILLIONS of microscopic fire-walls mixed in standard insulation constitute the newest challenge to flames which break out in one third



Testing fire-retardant insula-

of a million American homes each year. The fire walls are minute flakes of vermiculte, a non-metallic mineral which has its origin in mica. Researchers in the Fir-Tex laboratories developed a means of expanding the vermiculte flakes with heat, and then interlacing the flakes with wood fibers.

The non-metallic mineral flakes

prevent the spread of flames by forming millions of fire-stops in every insulating panel. Partitions constructed with the new lathboard, covered with poultry wire and plaster, prevented the spread of fire from one room of a house to a nother for more than an hour A partition of this construction also supported its normal, super-imposed weight during a fire for the same length of time

FORGE-WELDING

Heavy Welds Made

Easily as Spot-Welds

"FORGE-WELDING" is a new process of heavy-duty electric resistance welding for spot welding heavy steel and iron sections heretofore considered impossible to weld with conventional equipment.

Resistance forge-welding consists, first, in applying pressure to the work, then, interrupted current, and, finally, super-imposing a harmering action on the electrode. Under high pressure and with sufficient heat, the surfaces of work are brought into such intimate contact that when additional "impact-pressure" and intermittent heat are applied, a forged weld of superior quality is obtained

TRANSPARENT FABRICS

British Process

Increases Gloss

A NEW process has been developed by Imperial Chemical Industries (England) for making fabrics transparent and impermeable to fluids, at the same time increasing their gloss The new process consists in impregnating the fabric with non-drying oil or semi-drying oil-modified polyhydric alcohol nolyhasic acid resins in conjunction with urea-formaldehyde condensation products. It is claimed that the new process eliminates discoloration and tackiness when fabrics are subjected to heat treatment for short periods of time, also that it imparts excellent flexibility, soft handle, freedom from cracking or powdering and from objectionable tendering.

Dyed or printed fabrics may be treated as well as undyed material The treated fabric may be subjected to a mechanical finishing treatment, and may be printed with a nitrocellulose lacquer or with a pigmented composition. The fabrics may also be finished by the methods employed in the so-called "oil-silk" trade, such as coating with shellac, and material which has been treated locally may be finished by conventional processes

DITMD

Has Low Speed, High Capacity For Water

A PUMP which embodies an entirely new principle for pumping water, operates at the comparatively slow speed of 1760 revolutions per minute, and will deliver water against a head of 200 feet or more, has been developed by the Peerless Pump Division of Food Machinery Corporation It can be furnished in multi-stage units when service requires it It is particularly suitable for wells at darries small farms, country estates, industrial establishments, and so on.

The operating motor is on the ground level A long connecting shaft projects downward to the actual pumping unit which is at the bottom of the well This unit is the unique feature of the pump





Left: Impeller unit of the highlift pump described. Right: Sectional view of pump and motor

being described as a "helically contoured rotor." The rotating part is of stainless steel, and turns in a rubber stationary part having a similar shape which is called the stator. Water is lifted in amounts ranging from 300 to 5000 gallons per hour, with lifts up to 1000 feet by what the manufacturer calls "hypocycloida" action.



CORN INTO INDUSTRY

News that the Department of Agriculture will open a laboratory in Peoria, Illinois, for the study of corn as an aid to defense implies an extension of work to industrialize corn which has been carried forward by many agencies for the past several years. Corn is refined to create products that have dozens and dozens of uses aside from food, and now the possibility of using it to make synthetic rubber, plastics, fibers, and motor fuel will be explored.

Last spring, yarn, buttons, poker chips, and laminated boards, made from a corn by-product, were exhibited at the National Farm Chemurgic Conference, hence the possibilities sought by the Department are not remote.

The by-product which has already produced the above mentioned articles is a protein, zein, which constitutes about 10 percent of the whole corn. Its most superactical use at the moment is for coating paper. It is resists scuffing and the penetration of greases and oils Zein films are tasteless, dorless, and non-toxic Hence they are useful for food containers. Another use is in solid-color printing using amiline dyes. It is claimed that, using zein, fugitive dyes can be made more light that to the depth of t

There is such a thing as a zein plastic which can be molded and, when combined with other resins, can be used for impregnating and laminating Still a laboratory experiment is zein fiber made by extruding the protein in gelatinous form. It is claimed that its wet strength, elastic recovery, and abrasive resistance are better than those found in cellulose fiber.

The manufacture of synthetic rubber from comwould be highly desirable. With petroleum being used as a base for synthetic rubber, and corn being pushed as a source of alcohol for fuel to offset any possible shortage in petroleum, why not short circuit this performance by making the rubber from corn and leaving petroleum to serve strictly as a fuel?

THE VERSATILE BEAN

Protein fibers are being derived also from soybeans Two companies have produced them in the laboratory, when last heard from, one of the concerns was going ahead with a pilot plant for further experimentation. But this is not the only particular which corn and soybeans have in common. The soybean has become an industrial product with extraordinary rapidity and, if progress is maintained, it may yet nose out corn in relative importance, but this will take plenty of time and research. Oil from the beans goes into soaps, paints, and varnishes. The proteins in the meal can be made into parts for automobiles such as horn buttons, moldings, and small fittings, just like any plastic. Production of soybeans in this country has multiplied 17 times in the past six years and is still expanding. Hence, as technological competition with corn proceeds, so also does production of larger and still larger quantities of soybeans.

HIGH-SPEED CUTTING

A new alloy on the market is especially designed for fabrication into cutting tools. It is significant on two counts it represents another link in the long chain of developments aimed at the speeding up of metal cutting operations, it calls for a smaller tungsten content in its composition than is customarily found in high-speed steels. It does not fall within the classification of the tungsten carbides or tantalum carbides in hardness or cutting capacity, but is an all-purpose tool for general machine shop use, and is competitive with existing high speed steels.

Tungsten is one of those 17 strategic materials the use of which might be curtailed in event of real emergency, thus the new alloy is a real war-time product list tungsten content is 5 percent as compared with 18 popularly used, and, according to claims, the reduction in tungsten does not in any way impair cutting qualities nor the esse of handling during fabrication. It can be fabricated in raw form or finished tool without special precautions. Hitherto, low-tungsten, high-speed steels have been subject to severe carburization during the hardening process, hence special care had to be taken to avoid destroying the surface of the steel during processing.

FLUORESCENT LAMPS

Credit the fluorescent with one solution to a knotty lighting problem of modernization. When additional lighting is desired and no increase in wring is possible because conduits are imbedded in construction and cannot be replaced with larger sizes, fluorescent lamps will give more foot-candies per given amount of alternating current.

PERMANENT SUBSTITUTES

Out of effort expended to find substitutes for strategic materials may come products and processes superior in quality and lower in cost than those supplanted, hence they will outlast the emergency period and win a permanent place in industry. This explains why it is good business to keep up-to-date with all new developments—it keeps one in front of the procession.

Packaging is one of the fields likely to be permanently influenced by current developments. Now being sought are metallic substitutes for tim plating such as aluminum, silver, and tim-zine combinations for can coatings. There are also lacquers such as came to be used in beer cans. Besides metals for packaging some interesting products are coming on the market which employ plastics and coated cardboards with and without re-enforcements. Some will be seen on grocers' shelves very shortly.

BERYLLIUM AGAIN

This metal likes to step into the spotlight (See March 1840, page 142) A bill has been introduced to make it a strategic material subject to Government control, and reports have it that the War Department has tested the metal successfully for parts in the Garand rifle There's a lot rumbling here and facts may come to light soon

- Philin H. Smith

What Are Pattee's Caves?

Are They the Remains of a Medieval Irish Monastery in New Hampshire, as is Claimed?

HUGH O'NEILL HENCKEN, M.A., Ph.D., Litt.D.

T is now widely realized that Columbus was by no means the first European explorer to investigate the continent across the Atlantic The Icelandic sagas tell of Norse navigators of about 1000 a p who visited North America, and it is no longer seriously questioned that these stories contain a good deal of historical fact Claims have also been put forward for early Portuguese, Welsh, and Irish explorers, but on much less secure grounds

Especial interest has also attached to possible archeological traces left by these earliest translatant travelers But, up to now, though numerous discoveries have been reported, those acquainted with European buildings, inscriptions, weapons, and so on, of that time have either assigned the objects to a much later date than that attributed to the early voyages or have suspected fraud Still, one never knows at what moment the first genuine discovery may turn

One of the most secent claims of this kind has been put forward by the distinguished antiquary, Mr William B Goodwin, of Hartford Connecticut, who has suggested that a curious group of ruins known locally as Pattee's Caves. near North Salem in southeastern New Hampshire, is an Irish monastery In his view this monastery would have been founded by sailor monks like those who settled in Iceland before the Norse occupation in the latter part of the 9th Century.

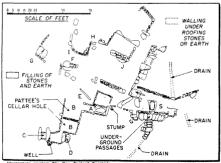
The largest ruin, marked B in both plan and drawing, appears to be the cellar-hole of a New England farm house Around it are remains of numerous rough ma-

The writer is greatly indebted to Mr. Ocodwin for every kind of assistance in examining these rules and their discount of the second of the se

sonry buildings with only a few patches of mortar Some are subterranean or semi-subterranean and are roofed with huge flat stones The walls also contain many big stone blocks

The most remarkable structure so-called "Y-Cavern" is the (marked "Underground Passages" on the plan), a narrow, branching, subterranean passage lined with stone walls, roofed with flat slabs and provided with numerous niches and a long drain Close to the Y-Cavern is a large flat stone marked S on the plan Around its upper surface a little way from the edge there is cut a narrow channel with an outlet at one end obviously designed to catch and drain off some liquid It has been called the Sacrificial Stone, though, needless to say, sacrifices requiring such equipment can hardly be associated with the ritual of the Church! Comparison is suggested with the old New England lve-stones These have such channels, though much smaller in dameter; a logshead of ashes used to be put in the middle and water seeped through to wash out the lye. Possibly the Sacrificial Stone may be something of this sort. But to interpret Pattee's Caves as a whole is very difficult They might conceivably have served as the out-buildings of a farm, but their size and number seem out of all proportion to the house which is known to have stood at the point B from 1832 to 1855, and which was not large

THE idea that the site was really an Irish monastery as old as the 9th or 10 Century, AD, has been suggested by a series of references in the Icelandic sagas to a country across the ocean called White Man's Land or Ireland the Great These sagas are long prose histories of the Norwegian families who began to settle in Iceland in the 9th Century, but they were not committed to writing before the middle of the 12th Century Some of them describe undoubtedly historical voyages to Wineland the Good (North America) about the year 1000. In these stories also occur the references to White Man's Land or Ireland the Great This place was said to lie west of Ireland, and there are hints that it was known to or occupied by Irishmen On the whole, however, the accounts of White Man's Land or Ireland the Great may be considered as folk-lore rather than historv



nutrations courter The New Instant Querter;
A plan of Patiec's Caverns, near North Salem, New Hampshire, which
some regard as remains of a monastery, others as an eccentric's work



A panoramic drawing of the same group of structures. The letters correspond in each illustration

The view that the site was really an Irish monastery was also suggested by the presumed likeness of Pattee's Caves to certain ancient structures in Ireland Now. in Ireland, as in many other parts of Europe, there are early stone buildings of several kinds and of several different periods But, despite a few superficial and generalized resemblances, the caves are not closely comparable to anything in Europe If one examines Irish monasteries of the early neriod, one finds that there are four features common to most of them surrounding walls called cashels. small rectangular churches, round towers and numerous contemporary graves often accompanied by inscribed and ornamented tombstones Not one of these occurs at Pattee's Caves. It is also safe to say that the New Hampshire site differs equally widely from Norse sites It may further be added that the caves bear equally little resemblance to anything ever built by Indians

What can local history tell us of these runs? One occupant is indeed fairly well known. He was a somewhat dubious character called Jonathan Pattee, who committed a robbery about 1826 and eluded search by fleeing to this place About 1822 to 1835 he built the farmhouse whose cellar-hole is shown here as B in the drawing and plan, and here he lived with his large family until his death in 1846. In 1855 the house was burned down and shortly afterward the

site was used as a stone quarry Tradition also can add something to historical fact, though as is often the case, it complicates rather than clarifies the issue The people of North Salem, including some of Pattee's descendents concur in ascribing all the buildings to Pattee himself But one of Pattee's sons is known to have said that his father did not build the structures, but "improved" them This expression might mean in old New England usage merely "occupied and kept up " Both of these traditions may contain a part of the truth

R GOODWIN, mentioned earlier, repair the Caves and in the course of this work a quantity of broken china and other objects dating between about 1790 and 1850 has come to light Assuming that the Pattee family probably arrived with some old or second-hand household equipment, these fragments are probably the remains of their possessions, or possibly in a few cases those of some immediste predecessor on the site. But despite suggestions to the contrary. nothing has turned up to indicate early Europeans.

There is, nevertheless, one find that may indicate that at least a part of the Caves was built before Pattee's time. Behind structure A there is a white pine stump 27 inches in diameter which apparently started to grow after structure A was built. The stump is

now so rotten that its rings cannot be counted, but a comparison with the diameter and number of rings of other newly cut pine stumps in the vicinity leads to the very generalized conclusions that probably the tree began to grow before Pattee's arrival in 1826, also that it is highly improbable that it began to grow before the Mauflower arrived in 1620. Hence the stump suggests that structure A may have been huilt before Pattee's time Indeed, this might explain why Pattee went there in the first place when he was a fugitive from justice But it certainly does not prove that Pattee's Caves were built prior to the white settlement of New England in the early 17th Century Hence one is forced to the conclusion that they were built after the white settlement.

Who, then, could have built Patiec's Caves and why? None of the objects found by Mr Goodwin seems to be older than 1790 The age of the white pine stump, which seems to be later than structure A, is not necessarily inconsistent with this, since it can be fixed only within broad limits But it would indicate that perhaps at least structure A was built before—but not very long before—Pattee's appearance in 1826.

Pattee, aided by his numerous family and perhaps a team of oxen, would have had no special difficulty in building the caves. What he built them for is another matter. The people of North Salem say that he was crazy.

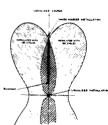
Blind Landing

Exhaustive Tests Show Effectiveness of System Being Installed at Six Airports

ALEXANDER KLEMIN

Aviation Editor, Scientific American In charge Daniel Ouggenheim School of Assynautica New York University

is a result of competitive bidding, and technical examination by the National Academy of Sciences, the blind landing system of the International Telephone Development Company has been accepted by the Civil Acronautics Board, and is being installed at six of the principal airports of the United States La Guardia, New York, Municipal Airports at Chicago, Cleveland, and Kansas City, Mines Field, Los Angeles and Meacham Field, Fort Worth If this blind landing system proves as effective in service as it has in ex-



How overlapping horizontal radio field patterns produce the runway localizer course

haustive tests, our airlines will become almost "weatherproof"

Radio navigation, with radio ranges, markers, radio compass, and so on, has been available for a number of years It makes it possible for a transport plane to fly to the viemity of its destination under almost any weather conditions. The more difficult problem is that of actually landing the airplane safely under conditions of low visibility. In radio navigation, low frequencies have proved fairly

satisfactory. In blind-landing systems, however, high frequencies of the order of 75 megacycles are supreme and indispensable

Why are short waves so overwhelmingly preferable to long waves? The reasons are clearly defined With short waves, state is reduced to a minimum. High directivity is an absolute requirement, and the radio signal must not be disturbed by ground trregularities, it is only the ultra short waves that seem to be almost immune to the presence of power lines, rivers, mountains, and other irrectivates.

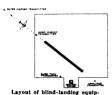


Cross Pointer Indicator

on the surface of the earth Antenna arrays are much cheaper and smaller with short than with the long radio waves

The main requirement of the blind-landing system is to provide a well-defined radio path, easy to locate, and one that will guide the aircraft in a natural glide to the approach end of the runway. To give the pilot ample time to orient

the airplane in preparation for the landing, he should be able to locate the glide path some distance from the airport. The pathway meeting these requirements is analogous to a long chute sloping towards the airport. The pilot's task is to keep the landing wheels within the chute and on the floor of the chute. so to speak. Such a chute is provided by a path of constant electric field intensity beginning at a point about five miles from the airport boundary. A glide-path transmitter at the airport furnishes the ultra high frequency power for this service and a specially de-



ment for use in one direction signed transmitting antenna estab-

lishes the constant field intensity along the path

The sides of the chute, providing lateral guidance, are given by overlapping radio fields A runway localizer transmitter and antenna installation is located off the end of the runway at the airport. Two overlapping horizontal field patterns produce the localizer course Each pattern is modulated with a different audio frequency and the course which the ship follows lies in the overlapped region where a signal of equal intensity is received from each pattern.

To take advantage of the path of constant field intensity and of the runway localizer, the pilot need only watch a Cross Pointer Indicator instrument in his cockpit. The



General impression of the blind landing system

vertical needle provides him with lateral guidance. The horizontal needle indicates altitude relative to the glide path. The pilot has only to control his ship so that the two needles are at right angles to one another to make a perfectly normal slide.

For further help to the pilot. two beacons are provided, located on the ground along the glide path, each projecting a narrow radio beam straight upward, to be received by the pilot as he passes by. One beacon is located two miles from the airport boundary and the other is at the airport boundary. The inner and outer marker beacons provide both audio and visual indications for the pilot. The general arrangement of the blindlanding system is shown in our illustrations. In one of them there is shown a typical layout of the four transmitters relative to the runway as installed for a single landing direction An airport can be equipped for any number of landing directions but the maximum is ordinarily four.

• • •

AUTOGIRO

One of our photographs shows the new Pitcairn direct-lake-off auto-glack the control of the cont

The PA-36 is not only of the direct-take-off type, but also of the direct control type. In which control is achieved by tilting the rotor fore-and-aft or laterally, so that perfect control is available even when the giro has no forward speed While direct control offers many advantages, bumps and other conditions, in earlier designs, transmitted rotor loads somewhat unpleasantly to the pilot's stick. These difficulties have now been removed by placing the axes of the flapping hinges close to the center of rotation.

The technique of the take-off is of considerable interest. Before the jump, through a hydraulic system, a single control lever locks the wheel brakes, sets the rotor blades at zero pitch, and engages the rotor clutch for power transmission to the rotor. Then the pilot advances the throttle, and since



Above. The PA-36 autogiro, showing engine compartment with cover removed. Below: Line shows vertical take-off



the blades are at zero pitch and in the position of minimum drag, they are over-revved to some revolutions per minute By the use of the same hydraulic device, the rotor blades are then set at their normal pitch, the transmission clutch is disconnected from the rotor, and the forward propeller receives a greater torque The rotor, now at lifting pitch but with a speed exceeding normal, exercises a lift greater than the weight of the aircraft Hence the jump, which continues until the blades have lost kinetic energy and speed. with rotor turning at about 170 revolutions per minute

An interesting feature of the new machine is a fairing of rubberized fabric which covers the hub and blades, reducing hub drag and eliminating end losses at the blade roots. The blades may be folded back over the horizontal tail surfaces of the machine on the ground, to reduce hangar space required or to permit the machine to be driven down a highway.

Our second photograph indicates the general mechanical arrangement of the machine The 175-horsepower air-cooled Warner aire in signer is placed behind the two occupants so as to improve vision and facilitate installation of the ground drive A drive shaft from the engine to the propeller passes forward on the side of the cabin There are clutches for the front propeller, for the rotor starter, and for the ground drive — A K.

SAFETY

When Taking-Off

From Sand

WE have often quoted from the Engineering News Letter of Aero Insurance Underwriters. Jerome Lederer, Chief Engineer of this company, has now become Director of the Safety Bureau of the Civil Aeronautics Board, and we consider this a magnificent appointment. The last News Letter written by Mr Lederer contains as usual at least one useful tip for flying safety Thus, he points out that revving up the engine on beaches or gravel surfaces results in a sand blasting of the blade, as small stones, sand, and so on, are sucked up into the airscrew Therefore, the engine should be revved up on an area free from gravel. If take-off must be made from sandy or gravel areas, the sand blasting effect can be reduced by opening the throttle slowly so that the increasing forward speed counteracts the suction from the increasing revolutions -A. K.

Plastic Metals

New Knowledge Provides Science with Better Answers about Metals' Inner Nature

SIDNEY J. FRENCH
Assistant Professor of Chemistry
at Coleans University

E LIVE in an age of modern plastics There are plastic buttons, plastic door-knobs, plastic combs and plastic clothes, there are plastic toys and plastic dinnerware, plastic pens and plastic radios. With all these remarkable products we are likely to overlook the greatest plastic of them allone known to man since time began-the plastic metals Old as these plastics are, it is only in recent times that we have begun to understand the true nature of their plasticity and its control What are some of the properties of these plastic metals?

To find this out let us enter the



Figure 1. Left Diagrammatic illustration of crystal block structure of a metal crystal. Right The crystal blocks echelonned

G-man's world for a brief moment A murder has been committed Officers at the scene of the crime pick up an empty revolver It is evidently the gun with which the crime was committed, but whose gun? The weapon is carefully examined for identification marbe but the registration number has been laboriously filed out by the clever crimal

Clever? No The criminal has wasted both time and energy The gun is taken to an expert metalographer who quickly swabs the filed spot with a suitable eiching agent In a moment the hidden numbers reappear once more The magic of the etch has done its work, the numbers are read and the first step in the solution of the crime is well started.

What is the story back of this magical production of numbers

where there were none before? Why does a simple acid solution produce numbers on a smooth piece of metal? It is all part of the story which the metallurgist calls the work-hardening of metals. It is a story of plasticity.

A friend of mine is an amateur silversmith, and a good one at that He tells me that, as he hammers away at his silver, shaping his objet d'art, the metal gradually becomes hard and brittle Soon he must stop and heat up the object. not to its melting point nor even till it softens, but merely to about 400 degrees, Fahrenheit, whereupon the silver becomes pliable and ductile once more So he goes alternately hammering and heating till the object is finished True there seems to be little connection between silversmithing and restoring the registry numbers of a gun with an etching agent, neverthe-less, both are phases of the same process, the work-hardening of metals

The questions the scientist is seeking answers to are, first, what causes metals to harden and become brittle when they are worked or hammered in the cold, and second, why does mere moderate heating cause these same metals to regain their plasticity once more? Until recently, science has been able to offer no explanations beyond the mere statement that it is "the nature of the beast" to behave as it does. Now, however better answers are being found as science probes into the intimate structures of metals

It has long been known that metals are made up of tmy crysals which can be observed under the microscope in a properly prepared specimen. Beyond and within these tmy crystals, where the microscope cannot penetrate, le most of the answers to work-hardening. Each microscopically visible crystal is, in turn, made up of myriads of infinitely smaller "crystal blocks" or units, whose structures can be inferred by their

effects upon the deeply-penetrating X-ray Even then we have not reached the ultimate sub-division of the crystal, which is the infinitesimally tiny atom. These atoms are the single bricks, just as the crystal blocks are the stories, and the microscopic crystals are the skyscrapers of this tiny crystal world. Just as the stories of a skyscraper rest upon one another in uniform pattern, window above window, so too, these crystal blocks rest upon one another, atom above atom in rows and columns in regular pattern throughout the entire crystal (Figure 1, at left)

Another analogy the atoms are the soldiers of a mighty company lined up in columns of fours Within the company are the squads, each squad of eight representing

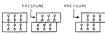


Figure 2: Illustrating elastic deformation. Left: Moderate pressure, atoms stay within recall. Right A permanent deformation

a crystal block, a unit in its own right, but nonetheless an integral part of the greater unit Each atom is alined with others of his block and each block is alined with all others of the entire crystal This is the perfect crystal seldom found in practice

Within the framework of the company, each squad exercises a certain degree of independence There is an old formation in military circles called marching in echelon At the given command each squad leader moves his squad obliquely to the right (or left) till it overlaps the squad ahead The column is said to be echelonned in depth This is just the sort of thing that happens when great pressure is placed on a metal crystal Each crystal block slides past its neighbor till the whole crystal is echelonned in depth (Figure 1, right) The scientist calls it plastic de-formation. If, however, the pressure is moderate, there may be no slipping beyond recall, but only a warping of atoms from their original positions When the pressure is released, the atoms spring back into formation once more and the crystal is intact (Figure 2, left) This is called elastic deformation.

It is a well-known fact that tall buildings lean out of alinement during strong wind, yet return promptly to normal position when the wind subsides, a good example of the elastic deformation of the metal framework. But suppose the construction were such that each story were simply set loosely upon the one below. Then it might be possible to move each story over (provided the building didn't fall down) till an upper window stood directly above a window which was formerly one space to the right. This is the sort of thing the scientist means when, in referring to metal crystals, he speaks of plastic deformation (Figure 2 right).

While all this may offer a suitable explanation of why metals may be flattened or drawn, it offers no explanation of why they harden and become brittle in the process It is here that science steps in with its theories, none of which can yet be finally verified.

One theory of work-hardening presumes that in the slipping of crystal blocks past one another, atoms from the surfaces of each are torn loose, to be scattered indiscriminately along the slip-planes between the blocks These mixed atoms, forming what the scientist likes to call an amorphous state, act as a sort of atomic glicusing the blocks to stick together (Figure 3, left) The farther the blocks are showed, the greater is the accumulation of this atomic glice and the greater becomes the

of corrugated iron over one another in a direction at right angles to the ridges and valleys and you have the virtual answer which this theory, known as the lattice distortion theory, gives to the problem As slipping progresses, the blocks become more distorted till further slipping is impossible. The limit of plastic deformation is reached.

THUS far, we have considered only a single microscopic crystal. In even a small piece of metal, however, there are thousands of these crystals, each, by chance, with its crystal blocks lined up in different directions, at all possible angles to abutting crystal neighbors (Figure 4. a) It is like a jumbled pile of glass bricks, except that there are no empty spaces Suppose we shove the pile of glass bricks. Some are pushed forward, some push then neighbors sidewise, or even backward. So it is with a pack of metal. crystals when pressure is put on the metal some crystal blocks slide in line with the pressure. these in turn force the blocks of abutting crystals to slide sidewise up, or down (Figure 4, b) The final net result of this jumble of slides is the same whether the pressure is a push, a pull or a hammer stroke, each crystal block is forced to its limit of plastic deformation Then the metal breaks

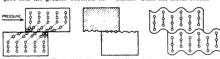


Figure 3. Left. Illustrating, diagrammatically as before, the "atomic glue" theory. Center The fragmentation theory. Right. The corrugation theory

resistance to further slip If the pressure is too great the crystal is ruptured between blocks, tearing the metal apart

A second theory explains the phenomenon in a somewhat different way As the blocks slip over one another, tiny fragments are torn loose to lodge along the slipplanes Crystal blocks under great pressure break on the crystal fragments which have so effectively sanded their smooth gliding planes (Figure 3, center).

Still a third theory gives another answer to the problem It assumes that, in the process of slipping, the blocks themselves become bent and corrugated (Figure 3, right). Try to slide two pieces

Yet, after heating, the metal is once more pliable without having lost the form into which it has been hammered. What happens to restore the pliability?

It was noted earlier that the striking tendency of the atoms is to line up in rows and columns, even when crystal blocks are shoved past one another. But this does not always happen Often, an unhappy atom in the face of one block is forced to stop midway between two atoms of an adjacent block Like the unfortunate neutral—between two nations at war—this atom strives to get into two positions at one time. Also, like the neutral, it is under a high state of strain But the pressure from all'

sides is too great, the atom cannot move, the strain remains (Figure 50) On the aurface of the metal however, the case is different there is no external pressure and misplaced atoms can line up in the nearest row. The surface strain is relieved

Now we are ready to solve the apparent mystery of the gun registry numbers. These numbers are stamped into the gun under high

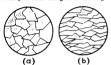


Figure 4. Drawing (a) shows normal crystal structure, blocks lined up in different directions.

(b) shows effect of cold working

pressure Filing has merely removed the unstrained surface around the numbers but it has not affected the deeply strained crytals below the numbers. The ething agent removes a thin layer above the strained crystals and then attacks them more vigorously than the unstrained neighboring crystals. Hence, the strained crystals underlying the numbers are most deeply etched and the numbers are reformed.

A metal under internal strain is a far from satisfactory product The first job of heating is to relieve this strain Atoms, even misplaced atoms in metals, are constantly in rapid vibiatory motion, the higher the temperature, the greater the vibration There comes a point in the heating of a metal when the vibration of the atoms is so great that, in spite of the internal pressure, misplaced atoms can swing themselves back into line once more This heating, the metallurgist properly calls stress relieving or recovery The misplaced atoms have recovered their rightful positions The temperature required for this process is not high Indeed. some metals "recover" at room temperature This simply means that they do not harden or become brittle when worked, for their atoms spring back into place as soon as the working stops Tin and lead are among such metals

Simple recovery, however, does not restore pliability to the metal The crystals are still elongated and distorted, as can well be observed under the mucroscope If the metal is heated somewhat hotter, a profound change, which can be followed with the microscope, begins The distorted, elongated crystals begin to disappear, to be replaced by new, small, well-formed crystalis. The amorphous atomic glue, the angular, braking fragments, the roughend corrugated crystal

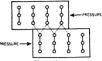


Figure 5. Illustrating one cause of internal strain: atoms which "can't make up their minds."
They do when the heat is put on

blocks have been swallowed up in the new crystals New glide planes have been formed Once more the metal is willing to be flattened, drawn, or pulled to the limit of its plast-ability

Thus does a metal pass through the phases of work-hardening and annealing A knowledge of plastic limits, of recovery temperatures, of recrystallization temperatures, is of the utmost importance to the practical worker in metals He knows them by instinct But the scientist is interested in more in the factors that motivate and promote these unique and fascinating changes in metals. He has learned much and he has much yet to learn As he answers the whys of metal behavior, the ancient art of metal working turns into the modern science of plastic metals

LESS FRICTION

Barium Film Lubricates Bearing In A Vacuum

A DISCOVERY that a metal film may be used to lubricate bearings in avacuum where ordinary lubricants are useless is reported in the September issue of the Journal of Applied Physics by Zed J Atlee, Jack T Wilson, and James C Filmer, engineers of the General Electric X-Ray Corporation

Vaporizing metallic barium to place a film on the steel ball bearings of a rotating anode target in an X-ray tube greatly reduced the friction, they reported Rotating anode bearings in X-ray tubes used for high power, high speed diagnostic work have been operated hitherto without lubrication

Use of the barium as a lubricant made possible a tube which not only operates much more quietly but also is one in which the bearing life is much longer. A number of other metallic films were found to have possibilities as lubricants but barium proved to be the most successful.

In one experiment an anode bearing was observed to have a sound level of 87 decibels, a speed of 3100 revolutions per minute, and a coasting time of 12 seconds. The barium film was then applied. In 30 seconds the sound in the same bearing was reduced to 68 decibels while the speed rose to 3560 revolutions per minute and the coasting time rose to eight minutes.

Under the normal operating temperatures of the X-ray load, the film will effectively lubricate an anode bearing for 50 to 100 hours of rotation.

"OILING" OIL

Wear-Prevention by Means of Addition Agents

The wear-prevention qualities of lubricating oil can be multiplied as much as 17 times by the addition of two groups of chemical agents, scientists of the Emeryville, California, laboratories of the Shell Development Company recently reported to the American Chemical Society

"There are two major groups of agents," these research workers said, "which, when added to lubricating oil, are able considerably to reduce wear These two groups have quite different functions

"The first group consists of organic compounds whose molecules take the form of long threads which are able to attach themselves by chemical forces, arising from the special structure of the molecules, to the surface of the metal. These compounds greatly increase thetightness with which a film of oil is held between the moving metal surfaces, even under high loads.

"However, the favorable effect of such agents is lost unless the metal surfaces themselves are highly polished and maintain their high polish in service. Even the best polish attainable by mechanical means leaves the surface covered with microscopic irregularity.

ties or roughnesses, and it is in the removal of these that the second type of addition agent finds its usefulness

"Addition agents of the second type have the property of combining, under the influence of the heat generated by the rubbing surfaces, with the surface layer of the metal to form low melting alloys. The result is that when the tiny hills on the surfaces become engaged with each other, isolated spots of very high temperature are produced at the points of contact which cause the surface layer of low-melting alloy to melt and flow just at those points where the hills come into contact.

"These chemical polishing agents are so chosen that the whole surface of the metal does not melt, nor even grow hot, but only the minute projecting roughnesses. In this way the surface of the metal is polished to a high degree while in motion and by write of its motion.

"Laboratory tests using highly less resintive apparatus, capable of reproducing wear measurements within an accuracy of 1 percent, have shown that the wear properties of a highly refined white oil, for example, can be improved tentimes by the addition of the chemical polishing agents alone. When both polishing and film holding agents are used this factor has been increased to 1.7 times."

SOUND ENERGY

Noise Speeds Chemical Reaction

Sound, without assistance from any other source of energy, can speed up the rate at which a chemical reaction takes place, Dr. Walter C. Schumb of Massachusetts Institute of Technology has reported to the American Chemical Society

Although it has been assumed by scientists that an intense sound has an accelerative effect on certain chemical reactions, Dr. Schumb is the first to prove that this increase in activity takes place because of the noise, as such, and not because of heat energy transmitted by mechanical vibrations.

Dr. Schumb and Mr. Edmund S. Rittner showed that sound energy produced by a rapidly vibrating nickel tube partly immersed in a solution is able, of itself and apart from any thermal effect, to hasten the speed of a chemical reaction. They carefully balanced out the heat effects resulting from the me-

chanical vibration of the solution so as to be able to establish the reality of the effect of the sound per se.

"We were not at this time attempting to widen the scope or applicability of this form of energy or to find new uses of the vibrating unit." Dr Schumb says, "Many such applications have been reported hitherto, such as the partial sterilization of milk, the preparation of various kinds of emulsions, including photographic emulsions. and the bringing about of certain oxidation processes The physical erosion of metal brought about when a liquid and a metal are in relatively rapid motion with respect to one another, as in the pitting of ship propeller blades, pump impellers, and hydraulic turbines, is of practical importance and has been studied with the same type of apparatus

STRAIN GAGE

Small Device Permits Study of Moving Parts

STRESS and stress distribution in such structures as the complicated members of airplanes, automobiles. railroad equipment, and bridges may now be determined and analyzed by a new strain gage This device makes use of the fact that strain changes the electrical reeistance of metallic conductors. It combines the accuracy of the testing laboratory with simplicity, convenience, and reliability. It is simply cemented to the member to be studied, has no clamps, no moving parts, no inertia distortion, and no hysteresis Once in place, a strain gage may be left permanently installed for months during which a complete study of the part on which it is attached may be made.

The SR-4 Metalectric strain gage and grain simply a small grid of specially selected metallic conductors. Its overall dimensions are ½ by 1½ by ¼ inches. It may, therefore, be installed in places inacessible to other forms of stress analyzers. In the accompanying photograph, the brass bar shown screwed on top is brass bar shown screwed on top is conducted to the strain gage has been comented into place.

This new gage is particularly suited to machinery operating at high speeds because it has no detectable inertia effects and has been tested at frequencies of over 30,000



An SR-4 strain gage



Strain rosettes

cycles per second, with no indication as to any upper limit to the response

An indication of the wide range of application of the Bonded Metalectric method of strain measurement is in its application to the two-dimensional strain rosette problem The strain rosette is a highly simplified instrument which is cemented as a unit to the surface under investigation. It contains four gage lines at 45-degree angles to each other, each of 34-inch gage length By connecting, in turn, the leads from the rosette to the control box, the amounts and directions of the principal stresses (axes of the stress elipse) of any surface can be accurately and rapidly determined

SCAVENGERS

Gold Fish Do a Job

For Research

THREE gold fish, costing 30 cents, have been put to work in General Electric's plastics research laboratory, doing the work which took seven hours' time of a chemist each week Since the fish find food in

the work they do, the upkeep or

A large glass jar is used in the laboratory for keeping a constant temperature bath for measuring viscosity in plastic materials. The inside of this jar had a tendency to collect scum, making the glass opaque Since it was necessary to make frequent observations of what took place in glass tubes inserted into this bath, the iar had to be emptied once or twice a week and scoured. The scum stuck and it was a tedious job to clean it Different acids were tried, but they didn't work Then three gold fish were put into the jar. They took to the scum like a kitten takes to milk, and within two or three days the scum had all disappeared That was three months ago, and since that time it has not been necessary to clean the bowl

DISAPPOINTED

Prospector Finds Remarkably Fine Mineral: Shrugs

When a Mexican prospector in the southwest stumbled on a vein of virteous material, he leased the deposit to others, since this was not the material for which he was looking. That vein has turned out to be one of the biggest calcite deposits ever discovered. Around the borders of the schist, crystals of calcite up to 1½ feet across grew out into the clay bed

Nothing like this had been discovered since the opening of the Iceland spar mine at Helgustadir When the operators of the new domestic mine approached Bausch & Lomb, largest user of optical grade calcite, the company contracted to take the entire output of optically suitable crystals. The result has been spectacular More than 500 pounds of fine spar crystals were taken out within a period of three months Imported crystals have averaged between two and four ounces and not more than 200 or 300 pounds a year have ever entered the United States none in late years. The new source the first of any consequence found in America, adds additional protection of the optical industry

The most important use of calcite is in the construction of Nicol prisms which are used in many scientific instruments designed both for laboratory purposes and as an aid to industry in checking the uniformity of its products

The Origin of the Earth

Astrophysicists Still Are Unable to Solve This Near-at-Home Problem with Finality

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

It is almost two years since Bethe published his beautiful explanation why the Sun keeps on shining Hydrogen supplied the fuel, helium formed the ashes, and carbon and nitrogen kept the process going by a chain of reactions at the end of which they were formed anew. The only doubt that could have been raised at that time was that two of the six steps in the cycle had not yet been observed in the laboratory, but had to be inferred from the theory of atomic nuclei.

Since then, both the missing links have been supplied by experiment Ordinary nitrogen nuclei, bombarded with protons, have been observed to form a light, radioactive isotope of oxygen, according to the equation Ni^{*} + H' = 0" + 6" (where 5" represents energy emitted as a gamma-ray). These oxygen nuclei emit positive electrons, and turn into heavy nitrogen, Ni^{*}

This isotope forms about one part in 260 of ordinary terrestrial nitrogen. It would be hard to study were it not for the recently developed methods of concentration which produce small amounts of introgen compounds greatly entithed in the heavier atoms Bombarding these with protons it has been found that the reaction predicted by Bethe

N¹⁵ + H' = C¹² + He⁴ is not only possible, but exceedingly probable Every direct hit of a proton on a heavy nitrogen nucleus breaks it up. The alternative reaction N¹⁵ + H' = O¹⁴ + \(\delta\), in which oxygen is formed and radiation emitted, is theoretically possible, that is the overlaid of the original processes, must be very much less likely to occur Bethe estimates that it will happen in only one case in a million

Bethe's anticipations have thus been confirmed in detail, and his theory now rests entirely on observed facts. His original predictions were, indeed, too cautious, for both of the nitrogen reactions are more probable than he originally estimated Under the conditions which prevail at the Sun's center, the average life of an N" nucleus, before a collision builds it up is estimated by Bethe as 4,000,-000 years That of N" is only 20 years For ordinary carbon, C", it is 2.500,000 years, for C", 50,000 years He points out that "these values may easily be wrong by a factor of about three either way" on account of the uncertainty in passing from the effects of the few. but violent, nuclear collisions which are produced in our experiments to those of the less violent, but more numerous, collisions inside the

HE later results are astrophys-THE later results are and the ically more satisfactory than the original estimates, according to which the life of N" was 50,000,-000 years On this basis, it was necessary to assume that nearly 10 percent, by weight, of the Sun's interior consisted of nitrogen in order to account for the production of energy at the known rate, at the central temperature and density, which can be pretty well estimated The new data reduce the calculated proportions of carbon and nitrogen each to about 0.5 percentwhich accords much better with the general spectroscopic evidence According to the new calculations. however, the abundance of N" in the Sun should be only 1/200,000 that of N" The heavier isotope is about 800 times more abundant than this on the Earth

This would raise serious difficulties, if we had strong reasons for believing that the composition of the inside of the Sun and the outside of the Earth were exactly similar. But there is no such reason, except for the assumption that the Earth was in some way formed out of matter expelled in some way from the interior of the Sun, or of some star of similar composition, and this assumption, so long accepted, is now in very serious difficulties

The high terrestrial abundance of heavy nitrogen does not stand alone Heavy hydrogen - deuterium-is approximately 1/5000 as abundant on Earth as the lighter isotope. But the deuterium nucleus is by far the easiest of all to disintegrate In the Sun's interior practically no deuterons should Bethe estimates their SHEVIVE number as certainly less than 10---18 that of the protons-one to a billion billions Moreover, terrestrial rocks contain small, but by no means negligible, amounts of hthium and beryllium, whose nuclei are the next easiest to break up. and would exist in only infinitesimal proportions inside the

We have here, not a difficulty with the otherwise well-established theory of the source of stellar energy, but something much more interesting and important We are apparently led straight to the conclusion that the matter which now forms the Earth (or, at least, its accessible exterior) has never been buried deep inside the Sun, or any other star Moreover, the same can be said about the surface layers of the Sun itself, for its spectrum shows lines of lithium and beryllium, faint but identifiable without question, showing that here, too, these fragile atoms must be vastly more abundantperhaps it would be better to sav. less rare-than in the Sun's interior

"Never" is a very bold word to use in a scientific statement. In its stricter sense, it is clearly not permissible, for it would mean that our statement was valid throughout an infinite past-which of course goes far beyond the limits of physical reasoning If, however, we interpret "never" to mean "not while the universe of stars has existed in its present general state," we can go far to justify its employment. Our reasoning is based on three things First comes the undeniable fact of the existence of deuterium. lithium, beryllium, and soon, on Earth. Second, we have the easily disintegrable character of their nucles, confirmed by numerous quantitative experiments. The conclusion that the mean lives of nuclei so easily disintegrated would be very short under the conditions which prevail in the Sun's interior appears to be very well founded The third pillar of the argument is the conviction that no process exists by which these light nuclei could be built up at such a rate. inside the Sun, that they might exist there in considerable abundance, despite their rapid decay. This proposition involves the familiar difficulty of proving a negative, and is, at the moment, less conclusively based than the other two But the number of ways in which these light nuclei could be built up out of lighter ones is strictly limited, and they have all been very carefully considered by Bethe with negative conclusions. That they could be formed by some sort of fission of heavier nuclei appears to be exceedingly improbable, for their available "packing" energy (per unit of mass) is high, while that of the heavy nuclei is low--so that such a process would have to be fed heavily with energy to keep it in operation

We must inquire whether a mass of very hot matter inside a star, containing very little of these light nuclei, might not reconstruct them out of the hydrogen present within it, if it were removed and allowed to cool But this would demand that, at some intermediate temperature and pressure, the atombuilding processes greatly outlines processes greatly outlines of the hose of disnitegration — which raises the difficulties just mentioned, in an aggravated form

Unless-or until-some way out of this impasse can be found, we appear to be shut up to the conclusion that the presence of these light elements on Earth and in the Sun's atmosphere is a survival from some primitive state of the universe, perhaps antedating the existence of the stars. We must conclude, also, that there has been little or no mixing between the Sun's surface layers and its deep interior Our present knowledge of stellar constitution does not forbid belief in this, though it by no means demands it.

Accepting this, there are various possibilities regarding the origin of the Earth (and presumably of the other planets).

1. The Earth may have been formed from the outer layers of the Sun (or of a companion star, as Lyttleton suggests), which re-

tained, or retained in part at least, its original chemical composition.

2 The Earth may have been formed from the Sun or some other star at an early stage in the star's history, when its interior was cool and the light elements had not been broken up

These suggestions have recently been made by Professor Bethe We merely add

3 The Earth, planets, and Sun may have been formed at some early epoch out of similar material, leaving the light atoms to be exhausted in the Sun's interior, but not elsewhere.

Bethe comments that, although there might be very little intermixture of the superficial and deeper material in an isolated and quiescent star, this "seems not very likely at the time of a catastrophe such as the formation of the planetary system" The question whether the brief but intense heating of the filament of matter swent off by a grazing collision of two stars would lead to the complete disintegration of light nuclei would deserve careful study, were it not that Spitzer's work has made it very doubtful whether such a filament could condense into planets

HIS difficulty applies with equal This difficulty appears of an encounter with the Sun in a primitive low-temperature state The additional objection that the Sun probably remained in such a state for a relatively short time, and that it is correspondingly improbable that it should have met an encounter in this interval, is less disturbing -- for it is well known among mathematicians and philosophers that there is great danger of fallacy in attempting to reason about the a priori probability of a single event. The assumption of a common and substantially simultaneous origin for the Sun and planets out of pre-existing material fits in well with the theory of the expanding universe, in Lemaître's form If, during the initial stages of the expansion, all existing matter was crowded into a volume very, very much smaller than it occupies at present, then-as Bethe says-"such a freak event as the formation of the planetary system could have occurred more

How it might have happened, no one yet dares to discuss in detail but the immense turbulence which would attend the early stages of Le-

maître's process offers possibilities which could hardly be met with elsewhere

But how did the more fragile atoms get there, anyhow? This question, which will not down in our minds, takes us to the boundary of the speculative—but not farther than we may properly follow it for a few moments.

The theory of nuclear changes inside the stars, in its present state, accounts for the production of atoms of only one kind—the inert and uninteresting helium Whether hydrogen is consumed, by Bethe's cyclic and catalytic process, or lithium, beryllium, and boron by what appear to be one-way, irreversible reactions, helium is the end-product The light atoms, excent belium are consumed and despite a very careful search of the possibilities by Bethe, no way of building up atoms heavier than oxygen, or perhaps neon, has been found. Hence we must accept as a part of the initial data of the problem of stellar energy the presence not only of the light atoms, but of the heavy ones, which form considerably more than half of the mass of most of the stars

Most of these, so far as we know. might have existed indefinitely in their present proportions, since, even inside the stars, their nuclei will not undergo sufficient violence to produce changes in them. But the heaviest atoms of all-thorium and the two isotopes of uraniumare radioactive, and decaying steadily. There seems to be no chance at all of building them up under the conditions which prevail inside the stars If they ever had still heavier parent atoms, these must have had shorter lives than their own (since they do not survive) For their formation, we must look to some state much more radically removed from the present than exists anywhere inside the Sun

It has been suggested informally by Bethe and others that these atoms might have been built up along with all the intermediate ones in an enormous mass of matter at a very high temperature (something like a billion degrees) and a fairly high density Whether something of this sort happened at the very beginning of the expansion of the universe, we do not know, but, apparently, if we wish to make sense of what we do know. we must carry our speculations as far back as this. It would not be easy to go farther

Dumps a Car a Minute

Engineers Construct World's Greatest Scientific and Speedy Coal Car Dumper

L. T. HENDERSON

ROVIDING car-to-ship coal handling equipment unsurpassed and speed, and increasing its already extensive facilities on Lake Erie at Sandusky, Ohio, the Pennsylvania Railroad recently placed in operation a new machine on a mile-long dock, with yards and supporting features, costing alto-

gether \$4,250,000.

With its other dumping machines working at near capacity season after season, the Pennsylvania Railroad decided to build a third machine. the equal of which never before had been con-structed The new dumper empties cars at the rate of 60 an hour and together with the railroad's two older machines, makes Sandusky one of the Great Lakes for the transfer of coal from railroad cars to vessels All three machines are of the liftand-turnover type, the new dumper being electrically operated, while the older two operate by steam

In addition to its important new facilities on land, the railroad constructed a new channel in Sandusky Bay whereby the vessels serving this port could be handled to and from the railroad's coaldumping equipment with a minimum amount of maneuvering The Sandusky coal-handling docks, conveniently situated as they are. provide an outstanding outlet for coal moved by rail from the southern coal fields through the Columbus, Cincinnati, and Louisville gateways

The docks and extensive supporting yard facilities are situated in the western part of Sandusky and the distance from the receiving yard on the south, through the classification and storage yards, to the outshore end of the newest of the three docks on Sandusky Bay is nearly five miles. The yards have a total capacity of 7800 cars

The latest developments in cardumper design have been incorporated in the new No 3 machine. with numerous automatic features for controlling and correlating the various operations necessary for swift, efficient, and careful handling of coal from the yards to the ships The powerful machine lifts

New mile-long dock and giant car-dumping machine are at left. Yards are below foreground

with ease the largest coal car-fully loaded -dumps the contents into the ship's hold, and returns the car to its original position, all in less than a minute

Loaded cars for the dumper are moved from the loaded car vard to the "ready" point at the foot of the inclined approach track of the machine by electric pusher locomotives Four of these powerful electric pushers are in use in the dock yard, operating on narrow gage tracks alongside the yard tracks. As each loaded car is placed at

the "ready" point, its wheels are engaged by a spring-type, constant pressure, car retarder which prevents it from moving until a unique conveyor, or barney (dock employes call it the "pig") contacts it from a pit beneath the loaded car and pushes it forward up the 15 percent incline and onto the elevating cradle of the dumping machine The cradle is equipped with a pneumatic car retarder which stops the car in the desired place before it is elevated for dumping

As the car rises, it is automatically moved to the dumping side of the cradle on a movable platform, and heavy steel clamps press against the top of the car, holding it securely as it is tilted to dump its load of coal onto the machine's pan

As the coal is transferred from the car onto the pan, an automatic, rubber-faced,

coal flow retarder of the movable baffle type controls the flow of coal by backing gently before its load, easing the coal into a telescopic chute for placing in the boat, which is tied up beneath the chute The combination gate and trimmer at the lower end of the telescopic chute are controlled so expertly that the coal is practically laid in the hold of the vessel This careful handling prevents dropping or bouncing, and the coal reaches the hold in as good condition as it was in the car The machine has a high-



The "pig" (or barney), pulled by hoist, pushing car up into No. S

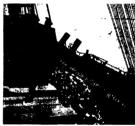
pressure water line to dislodge any coal adhering to the bottom or sides of the

Another feature of the dumping operation is the automatically - controlled sprinkling equipment mounted on the coal flow retarder, which moistens the coal to the exact degree specified by the coal shipper or receiver

Immediately after the car has been emptied and returned to its original position on the cradle, it is pushed off by the next loaded car and descends a 7 percent grade leading to



e kick-back trestle of the new dumper, and, ond, the loaded-car and empty-car yards



Moving from car, left, to pan, the coal is sprayed to regulate moisture content

the kick-back trestle, which ieverses the movement of the car and sends it, by means of a spring switch, onto the lead to the empty car yard However, before entering the empty yard, which is on a 045 percent descending grade, the car passes through a pneumatically-controlled car retarder, which regulates its speed.

Three operators control all movements of the car One is in a cabin on the approach side of the tower of the machine at a level 12 feet above the cradle This operator controls the barney, or "pig." and the car retarder on the cradle and also starts the cradle in its lifting operation. Another operator, in a cabin at a point above the pan, controls the cradle hoist, the pan and the pan girder, the sprinkler system, and the flow retarder The third operator, stationed in a cabin at the outer end of the pan manipulates the pan, the chute, and the trimmer gates, and also the controls for raising and lowering the pan girder The operators' cabins are connected with each other and with the dispatcher's and foreman's offices by telephone, microphone. and loudspeaker equipment

The barney moves up the incline with a loaded car at a maximum speed of 11 miles an hour and returns to the pit at a maximum speed of 17 miles an hour, making the round trip in 55 seconds. The cradle's complete dumping cycle is 48 seconds

Electrical power for the dumper is provided

by a power company in the form of three-phase, 60-cycle current at 23,000 volts, which is reduced to 2300 volts by a substation on the nramicae

The new dumping machine is situated 585 feet from the outshore end of an earth-fill dock which is 4500 feet long and 600 feet wide and represents, in itself, one of the greatest construction projects undertaken in the Middle West in recent years Along the westerly side of the dock, the fill material is retained behind a stone revetment. while on the easterly side, which is the loading side, a steel sheetpile bulkhead of cellular construction was built and surmounted by a reinforced concrete dock wall A total of 91/4 million pounds of steel sheeting went into the construction of the rock-filled cells of the dock wall and more than 244 million pounds of steel piling support the concrete cap which tops the cells and forms the floor of the pier The piling was driven to

solid rock. The dock wall and foundation for the car dumping machine required 14,000 cubic yards of concrete

A new ship channel was dredged, requiring the removal, by the hydraulic process, of 2½ million cubic yards of soil Nearly twothirds of the soil removed was used to fill in the area between the dock wall on the east and the dike, approximately 600 feet to the west, and on this made land are the new dumping machine, vards, and other supporting facilities.

The new dock yard has a capacity of 550 cars-350 in the loaded yard and 200 in the

empty yard-and was planned to provide for future development even to the installation of another car dumper, complete with supporting car yards

The channel work included a new 400-foot dock channel, 22 feet deep, along the east side of the dock, a new approach channel 300 feet wide, 22 feet deep and 8000 feet long, parallel with the original ship channel, and 3000 feet bayward therefrom, connecting with the entrance channel to Sandusky Bay, near Cedar Point. Thus was formed a loop which permits vessels to enter the slip along the new dock via the original channel and to leave by means of the new channel Ships loading at the No 1 and No 2 coal dumping machines also use the new channels. thereby expediting the maneuvering of the boats

NITRIDED STAINLESS

To the corrosion resistance and strength of stainless steel has now been added surface abrasion resistance by the process of nitriding. The new nitrided stainless steel is being adapted to steam valves, in textile machines, for parts in oil well pumps, and the like.

CANTONMENTS

Extensive Engineering Necessary In Building Camps

HE country is launched upon one of the largest single engineering jobs it has undertaken for many a day It will build at high speed numerous camps for our National Guard and conscripted armies

We are inclined to overlook the fact that there is more to a Conscription Law than mere passage by Congress and registration and drafting of men World War camps and other sites will be cleared of stands of scrub timber and of the evidences of cultivation Speedy work must then he done with excavators, tractors, and trucks, in preparing foundations, payed streets, street lighting, and all the required numerous facilities Where semi-permanent barracks are being constructed, they will more often be two stories and (World War Veterans take note!) will be equipped with heat, shower. and toilet equipment

Cost of temporary barracks at army posts is expected to run to more that \$350,000,000 Many hundred millions of board-feet of lumber will be required as well as proportionate quantities of cement. bricks electric wiring, and the like It is believed that World War construction mistakes will be avoided

BALL TANK

Sphere, For Water, Tops Enclosed Tower

THE photograph on this page does not show the beginning of construction for a World's Fair, it is one of 10 water tanks of the balancedball-on-pin design that have been built by Chicago Bridge & Iron Company This particular tank was built for the town of Longmont. Colorado, and has a capacity of 100,000 gallons of water Height is 60 feet to the bottom of the sphere Others of the type have been built with greater water capacity and considerably higher than

ELECTRIC HAMMER

Development Presented

Special Problems

ONE of the things that has made American industry great is the fact that our engineers like nothing better than to tackle and lick a tough problem, whether it be in design, production methods, or materials In the manufacture of portable tools, the electric hammer has been one of the most difficult to make.

Twenty years ago the Wodack



Electric Tool Corporation set itself the task of manufacturing an electric hammer for drilling concrete. and has been at it ever since, says Nickel Steel Topics A simple and practically trouble-free hammer mechanism has been evolved, but due to the terrific strain on the hammer parts in striking 2400 blows a minute, the greatest problem to solve was in finding a sufficiently strong and shock-resistant



Representative models of the electric hammer described here. The hammer-holding chuck can be seen through the case hole

alloy steel and heat treatment that would give a reasonably long life to the working parts A nickel alloy steel supplied the final solution of the problem

The outstanding feature in the design of the Wodack "Do-All" electric hammer is that by loosening a cap screw and opening the chuck, the hammer member is removed and the power member can be used as an electric drill and grinder The hammer drills holes in concrete and masonry as large as 1% inches diameter and the drill has a rating of % of an inch in metal The "Do-All" finds its greatest use in the building construction field but it is also extensively used as an industrial maintenance and installation tool for drilling holes for expansion bolts and screw anchors

COUNTY MAPS

Show All Rural Structures In Most U. S. Counties

A NEW kind of county map, showing all highways and all structures in rural areas, will soon be available through state highway departments Drafting work on sheets covering 2741 counties - or approximately 90 percent of the counties in the United States - has been completed. According to the Public Roads Administration, such maps will soon be completed for all counties in every state and many of the state highway departments already have them available for general use

Their details range from the railroads, highways, roads, and bridges to the separate dwellings, farm units, and stores and industrial plants in the rural areas Distinction is made between occupied and vacant structures Streams actually navigable are shown Also shown are such details as schools, hospitals, churches, cemeteries, camps or lodges, oil and gas wells, mines and quarries, power plants, radio stations, and air fields

These maps are being used by business organizations and government agencies in addition to their use in highway planning In 29 states, they were used by the Census Bureau for laving out the field work of the enumerators employed in the 1940 census and in fixing boundary limits around the settled areas of un-incorporated urban communities of 1000 or more population.

Life's Debt to Death

Nature's Attempts to Circumvent Death in Her Species May Suggest Conscious Purpose

EDWIN R. BOGUSCH

THE moment an organism begins to live it starts its relentless struggle against the forces of death. Every phase of its living existence is an expression of its effort to out-wit nature, for in the plant and animal world there is no divine right to life That belief exists only in the imagination of man.

The survival of the individual is unimportant in this battle for existence. The perpetuation of the race supersedes in importance the life of any single member of that race. Under the stimulus of approaching death living beings hasten reproduction to levels of activity abnormal to the species.

When that plant curiosity known as the agave or century plant has completed its normal span of life it produces root-sprouts at its base even before the giant flower stalk saps the last of the vital energy of the plant in its culminating triumph of reproduction But, should something injure a normal, vigorous century plant still young and far from maturity, the plant responds with amazing concentration of energies to produce root-sprouts and provide for another generation The activities of gnawing animals or fungi upon the roots stimulate the adjacent region to the growth of buds and new plants

Some of our common trees, like the black locust, are so prolife in this type of response to root injury that even any interference with the normal flow of the vital water through the roots will result in root-sprouts Just the shrinking of dry soil about the roots, that may strain and tear the tissues, stimulates this development. Botanists call this wound-stimulus. The result is an apparent effort of the plant to perpetuate the species even before the certainty of approaching death becomes established

Similarly, when yeast plants fermenting in the bottom of a brewer's vat are subjected to higher than normal temperatures, the yeasts stop growth and undergo an entirely different physiological process. The cell contents separate into an even number of rounded bodies, each with an individual membrane Later, when the mother cell breaks down and disintegrates, the newly formed spores are set free Each is now a resistant individual capable of withstanding sustained high temperatures, extremes of desiccation, and even freezing; each can under optimum conditions resume life again where the parent cell was forced to stop

A most the lesser forms of plant her, such as the molds and other fungi, when food becomes scarce further growth diminishes and the plant body expends its remaining energies in the production of reproductive spores. In stagmant ponds where green and blue-green algae abound, summer temperatures evaporate the water, concentrate the minerals, and stimulate rapid sportulation to guard the continuity of the species even though the parent must of necessity die.

Indeed, it is now believed that our animal and plant life has so abundantly survived because it adapted itself to seasonal conditions ahead of the time that those conditions were felt. Where the migrating bird flees southward in autumn because it must live to carry on the species to nesting time. plants developed an annual seed habit That seed in which the tiny plant embryo nestles dormant and unaffected by winter owes its existence to the fact that the parent plant devoted all its energies to producing those seeds before frost. instead of storing an accumulation of food in its own roots for another season's growth

Conversely, certain species commonly believed to be of tropical origin, such as the banana and the canna, have nearly or entirely lost the seed habit in the warm tropical environment, where seasons have no extremes and where the need for a dormant, resistant propagule is no longer felt

So definite and close is the response of certain plants to factors associated with seasonal change as associated height of the day will have an immediate effect upon a particular generation. Thus the poinsettia, which normally flowers at Christians time may be made to produce its highly colored blossoms in mid-summer if the length of the day is artificially shortened by darkening the plant a part of each day Likewise, in the case of the Mammoth strain of tobacco



How the century plant doubly insures the perpetuation of its species

which in the latitude of Maryland devotes its entire development to leaves, the plant must be grown in greenhouses in winter during shorter days if it is to seed or, if it is to seed profusely, it must be planted and grown in Florida, where the summer day is shorter than that of Maryland Shorter days herald the approach of winer, and tobacco is one of those

plants which are adjusted to anticipate the change of seasons in this manner by the production of seed

Dry, hot winds of a Central Plains summer, icy arctic blasts of a late frost, inundation from an overflow-each in its own way exacts a toll from the life it affects, each brings death to the individual. Yet, none of these forces can work the extermination of the species, for, as death stalks, new life 18 prepared and laid to rest in the shroud of its dead parent to await another spring No wonder man, in his groping toward an understanding of the Universe, conceived of the immortality of the soul!

So, in this endless quest for life a feeble, bent broomweed blossoms with starry yellow

flowers beside a burning hot roadside, the homely carrot of the garden rushes into bloom after a sudden late frost and dies with seed matured, instead of growing a healthy, tuberous root, a nearly drowned willow or aspen blooms once more as the slowly rising waters impounded behind a dam bestin the tree's destruction.

Nor are plants the only victims of these natural tragedies, animal life responds to the extent of its ability The caterpillar enters its pupal stage in advance of its normal time following an injury, the viviparous fly releases its maggots when trapped or hurt, the hen stops laying and starts incubating her eggs ahead of time with the arrival of hot weather And this should not seem strange, for the human mother, without volition and through forces completely beyond her control, may enter labor and give premature birth to her child when fear, shock, or physical injury threatens her own life It is the unconscious response to danger threatening the survival of the species. In one last valiant effort the body strains to thwart the grim reaper Though dying, the body, whether human, animal, or plant, sets into the world a new spark of life with which the continuity of the kind may be maintained.

Then there is the example of the bee, whose communal life has be-



If an insect lays its eggs in a prickly pear, growth is started anew and the new pads fall off and take root

come classic Among the bees, with their perfect division of labor according to the individual's ability. the perpetuation of the kind is left entirely to the queen-mother. She weds with the drone, who, when his mission in life is done, is rewarded by death so that the food supply of the hive will not be needlessly expended He is either cast out to die of starvation or mercifully stung to death by the workers The queen-mother lays the eggs The workers-all of which are sterile females and the old maids of the insect world-attend to the young, do all the necessary work, but never reproduce their kind. Indeed reproduction on their part would be totally impossible.

In spite of the seeming fixedness of the potentialities of each member of the bee colony, the species still holds a trump card in its battle with death. Should death destroy the queen-mother, the species must play this card in order to survive.

If no other queen is at hand, the egg destined to be a worker is placed in another cell and nourished to become a queen-mother shed to become a queen-mother shed to become a queen-mother worker will in some mysterious manner become a fertile female, assume the role of the queen-mother, and carry on the continuity of its kind. The chain of old life must remain unbroken in order to exist.

most supernatural feature of this power to carry on reproduction is that it lies beyond the realm of voluntary control and almost beyond the powers of human comprehension Ante whose colonial habits rival and sometimes exceed those of the bee likewise can under conditions threatening the extermination of the species produce a queen-mother to continue the creation of progeny Those ant-like

wood-digesting insects

known as termites are

likewise so endowed

And the result is an

enormous potentiality

to live and a wonderful

ability to beat death's effort to eliminate a spe-

cies through the de-

struction of the individ-

The strange and al-

uals commonplace are the More unique relationships existing between organisms of different origin. The end-results of their mutual activities continue to stimulate the perpetuation of their own kind Everyone has seen the warty, knotlike growths on the twigs and leaves of such trees as oak, hackberry, elm, and others These galls are the consequence of the stimulus provided by an insect which stings the affected plant part to deposit its own eggs The plant, to defeat self-destruction, develops corky tissues which in turn provide shel-

ter for the larvee of the insect. Among that large group of cactiknown variously as prickly pear as cance cactus, the sting of an egg-as cance cactus, the sting of an egg-depositing insect upon the seed-bearing part of the flower produces startling development. The particular insect associated with this cacculation was also startling development which the seeds are to mature and deposits its eggs within the plant over. The



In bryophyllum, if the roots rot, each leaf produces new plants at the margin. These later fall off and take root. Thus the species lives on

cactus, whose own progeny are now endangered, is stimulated to renewed growth and promptly produces a new flower from the summit or the side of the old ovary Should an insect again sting the new seed container, the cactus responds again in a similar manner

The final result may be a chain of ovaries attached to each other, each representing the plant's involuntary effort to perpetuate its kind against the forces threatening its death Dr. Rose, who before his death stood as the world's foremost authority on cacti, reported cactus plants in the southwestern deserts with chains of such proliferating ovaries several feet in length

Thus each organism, in its own way, works against death and, because of that constaint threat, provides in the most ingenious of ways to insure life for its children The pathetic effort of an apricot tree whose life is doomed through frost injury to flower and fruit out of season in one valiant last effort to make seed is a drama in survival. The early maturity of the fruit of the virus-such peach tree is a similar effort to beat death to the punch.

Likewise, the peculiar response of the so-called aur-plant, Bry-ophyllum, whose leaves produce miniature plants upon its margin, is peculiarly adapted to survival. In its native tropics, when high humidity induced destructive rot to ruin the roots and stem of the plant and thus doom it to death, each leaf creates its share of small plants. These later fall to earth when soil

conditions are again more favor-

Man, through his powers of reason and observation, has come to recognize how he may develop these peculiarities of plants and animals to his own ends. He has discovered that certain chemical substances known as hormones are really powerful poisons which in extreme dilutions stimulate dormant plant cells to develop roots where none would normally appear. So now he places cuttings of plants in hormone solutions and in an amazingly short time grows roots on even very obstreperous species.

Or man plays with the delicate germ plasm of certain animals and fungs under the odd and dangerous light of the X-ray and finds that evolution has been enormously hastened and even diverted into peculiar new channels What will he get? A new species of interesting value? That depends upon the human interpretation and definition of a species Scientific logic states that it is still the same old species, fighting a form of death by developing a mass of individuals. among which may be some more able than the rest to survive

Thus all life owes a debt to death, for death stimulates powers within the living being to fight more effectively the forces which threaten its destruction

The Auto Show Moves In

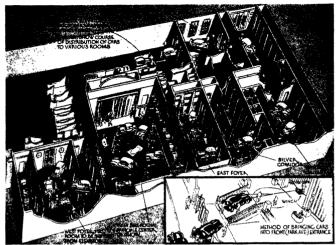
Mechanics of Handling the Cars and Other Displays in the Ballrooms of a Huge Hotel

H. T. RUTLEDGE

URGING crowds surround the gleaming 1941 model motor cars in the main ballroom. In five adjoining salons are more cars, other mechanical displays of the automobile manufacturer's skill. more crowds Yet only a relatively few hours before the first spectator looked upon this exhibit, these same rooms were devoted to the routine affairs of modern metropolitan hotel activity. So perfect rs the setting for the motorcar show, however, that one might be almost willing to believe that the space so occupied was originally designed for just that purpose. And so it was, in the case of the Waldorf-Astoria Hotel in New York City where, a few days ago, was presented the annual General Motors display of their new models

When the hotel was under construction, some 10 years ago, representatives of the motor-car manufacturer gave whole-hearted co-operation to the architects and builders Even before the hotel was started, it had been decided that General Motors would hold its own annual display in the Waldorf-Astoria, in addition to participation in the Grand Central Palace Show. Knowing full well the headaches that accompany the presentation of an automobile display in buildings not designed for the purpose, officials of the manufacturing company were anxious to forestall future trouble

As a result of this foresight, it is not only possible to make the best use of the available space for displaying cars, but also to bring in



Preparing for the auto show at the Waldorf. Inset. How lobby display cars are brought in

the cars and other equipment with a minimum of difficulty and a maximum of speed Surrounding the Grand Ballroom at the Waldorf are five smaller salons-suitable for individual displays by General Motors car divisions. A template layout of the ballroom floor is made for each annual show, and the number of cars to go in each salon is decided. Of course, all of the car divisions want to have mechanized exhibits such as cutaway chassis and transmission displays in addition to the show cars. so it is necessary to subtract car space to make way for these animated attention-getters However, the choice of display material is left, insofar as possible, to the individual car divisions

Information on what is to be displayed must be available well in advance of show dates, because preparations must be made to provide adequate electrical connections for each exhibit Every car on the floor has special interior lighting, some of the revolving chassis require 220 volt current, some displays use A C.; others D C., and so on The practice has been established to furnish all of this essenital information to the hotel engineers well in advance of the show so that when the show-date arrives the electrical connections are all in place and ready for use

There is a very definite limit to the time alloted for the actual setup of the show. A special invitation preview is to be held at o'clock on the afternoon of the day before the Auto Show opens to the public As a margin of safety, the deadline for having the show shipshape is set for 12 noon

By advance arrangement, the three small ballrooms nearest the freight elevator are cleared for action 56 hours before the deadline Dozens of crates and boxes of all shapes and sizes, packed with panels, sections of wall, canopies, decorative fabrics, and numberless articles of ornamental and utilitarian nature are hurried into these rooms and unpacked Time and space must be found to dispose of all of the crates and boxes, to say nothing of the task of putting together the many sections which, when assembled, make up the elaborate decorations.

Swarms of workmen, most of them old hands at the game, hustle the bulky panels and decorative pieces into a semblance of order so that the moment the Grand Ballroom is declared available the pieces can be fitted into the positions for which they were built. The entire ballroom floor is available for the decorators just 32 hours before deadline. Then the transformation begins

Special equipment to facilitate the job has been provided by the Waldorf engineers. One unique tool is a miniature detrick which is used to host canopies of substantial size and weight into position over main entrances. Another is a tall, scaffold-like dolly for setting up huge panels which border the main ball-room.

Each piece of decorative panelling, when designed has to be divided into pieces small enough to meet certain physical limitations, such as the length of the freight elevator, the sharp turns in the corridors, low doorways, and so on They must be lashed, not nailed or screwed into position. No damage must be done to the walls or pillars of the ballroom.

Twelve hours before the deadline, the first cars and displays are brought up on the huge elevator. It would seem that the job should be simple—just put the cars on the elevator and push them into place on the ballroom floor, but it is not quite that easy. There are six different makes of General Motoacrar, in addition to displays by Frigidaire, Fisher Body, Research Laboratories, Delco Appliance, GMAC, GEIC, Customer Research, Diesel Engine, and others Some require a lot of time to set up, some are practically ready for the show the moment they are in place, some are to be centered in rooms through which other cars and exhibits must pass in order to reach their proper position. Here is a job that calls for organization.

When Auto Show cars are shipped to New York, they are directed to the storage places of the various divisions which are in somewhat scattered locations around Manhattan Cars addressed to the big show at the Grand Central Palace must not be confused with those consigned to the Waldorf show The Waldorf cars by direction of a GM Central Office co-ordinator, are each assigned a number A large tag bearing the number is placed in plain view on the radiator grille or bumper

At the hotel, the only route from the freight elevator to the Grand Ballroom that can be maneuvered by long-wheelbase cars is a roundabout passage through four of the parlors in which cars are to be displayed, a distance of between 400 and 500 feet. This means that car #1 must be the car consigned to the farthermost point from the elevator so that it can find free passage through the rooms without interference from other cars or displays being placed in position Each succeeding car fills in the most distant spaces from the elevator until the last unit occupies a spot just a short distance from the elevator

None of the cars may be driven -they must be trucked to the hotel It is obvious that the truckers must be on their toes to get the low number cars delivered first Chevrolets, Pontiacs, Oldsmobiles, Buicks, LaSalles, Cadillacs-all must be picked up at different storerooms and brought to the Waldorf so that no time is wasted in getting them on the elevator in proper numerical order in relation to the numbered floor plan Also, large exhibits, such as chassis and cutaway motors, must be moved in simultaneously, so that their entrance dove-tails into the car movement at just the right time.

Then, too, there is the fact that it takes longer to set up a cut-away

chassis than it does to place a car in position Squarely in the center of the Buick salon may be the spot selected for such a chassis, and a start cannot be made on putting it up until every single car which is consigned to the rooms beyond has passed through. With this problem in mind, a "time-in and set-up schedule" is prepared If it is found that six hours will be required to get the chassis functioning, particular care is taken to be sure that all of the cars scheduled to be displayed in rooms beyond the Buick salon are in place before 6 A. M., allowing a full six hours for the Buick men to finish their task by deadline.

Even getting the cars properly located involves more than meets the eye. Ramps are laid to make it possible for the cars to climb steps Rubber-tured jacks are used to jockey the units into exact position, with space for traffic carefully calculated Gas tanks are drained, batteries disconnected, spring shackles are wiped free of grease, oil is drained, and interior illumination is installed. These seems to be no end to the destails

Time, time, time ... the deadline has come and that four-hour margin of safety was a good thing There is still some work to be done on exhibit set-up and the cleaning has necessarily lagged behind while work is still giong on. Finally, with one hour to spare, the last car is polished and the show is ready There have been times, however, when, twenty minutes before 4 o'clock, the ballroom looked hopelessly in disorder, but somehow or other the work got done, just in the nick of time

Over and above all of the ballroom activity is still another job which must be handled in the wee hours of the morning of show day It has been the custom to display a Cadıllac car in the main lobby of the hotel, at the head of the steps near the Park Avenue entrance. There is only one way to get it in, by removing a door and frame, pushing the car over the sidewalk and through the door, and then getting it up the full flight of steps. It's a tight squeeze through the door, and another tight squeeze to get the lengthy unit around the corner so that it is headed straight up the stairway. A capstan is anchored to two huge pillars across the fover opposite the head of the stairs, which pulls the car neatly up the steps on planks. It has even been necessary, when Cadillac planned to build a wider car than production models of previous vears, to build a crate, weeks before the show, corresponding exactly with the outside dimensions of the car, and move the crate into the lobby as a sure check that the car would fit

The Waldorf show has become a tradition in General Motors It is the high point of announcement time, and assumes great importance as a stimulus in giving the new models a good start During the annual motor show week. Detroit literally moves to New York and takes over the town, and as far as that goes, the entire nation Automobiles are the topic of conversation everywhere, and the already automobile - conscious American public digests a whole new chapter of the History of Automobile Progress

BATTERY

Storage Type For Flashlights

It is user of a flashlight is faced not only with the expense of frequent renewals but also with the occasional necessity for using batteries that are weak and give a poor light. The Ideal Commutator Dresser Company has wiped away both these disadvantages with one stroke in the development of a storage battery for flashlights.

This new battery takes the place of two 1½-inch, size D dry cells Its upper section is made of Dupont's Lucite, as that material is impervious to battery acid. This

transparent material enables the user to see whether distilled water may be needed at any time, this water being added by unscrewing the top cap and dropping the water in with a medicine dropper

LONG-LIVED FUNGUS

STARVATION and other unfavorable conditions seem to make no difference in the life of at least one fungus—that which causes the stem rot of rice. The Department of Agriculture says, therefore, that it is not practicable to try to control this plant disease by rotation of crops. A six-year test was carried out.

by the Department's experts by screening infested soil to prevent



Above The Solovox, a musical supplement to the piano, has a six-octave range and an indefinite variety of tone colors. Below: Solovox keyboard

right hand. Thus he can augment the brilliant percussive tones of the plano with a tremendous variety of tone colors, some of which suggest the shrill quality of the piccolo, others of which suggest the singing tones of the violin and the piercing tones of the brasses. The Solovox is easy to play and can be picked up by even the self-made planist in a few hours The Solovox is an instrument whose market possibilities are, numerically speaking, 1000 times greater that the organ due to its comparatively inexpensive price under \$200

MULTITUDINOUS

Bacteria In Ocean Use More

Oxygen Than Fish

Oxygen in the ocean is probably used up more rapidly by bacteria and other micro-organisms than it is by all the fish and other visible

new infestation. After the six years elapsed, they found some of the sclerotia still in condition to renew activity and cause the disease whenever there was rice tissue on which the tungus could grow.

SOLOVOX

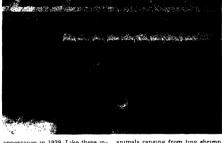
Fascinating Sound Effects

With the Pigno

A New electronic musical instrument—the Solovox, designed to be played with the piano—was introduced recently by Dr Frank Black, music director of NEC on the Cities Service program Bolt musicans and piano manufacturers believe that it will stimulate new interest in the tradition of music in the home and will have a stimulating effect on the piano institution.

According to Dr Fritz Reiner, "Laurens Hammond's new instrument, the Solovox, is not only an outstanding technical contribution to the number of electrical instruments but also a musical one Its endless possibilities for creating new and fascinating sound effects in combination with the piano, will kindle the imagination of every pianist in fact, the Solovox may revitalize the present siyle of writing for the piano."

The Solovox is Mr Hammond's third contribution to electronic music, its predecessors being the electric pipeless organ which was first introduced in 1935 and the Novachord, which made its first



appearance in 1939 Like these instruments, the Solovox is entirely electrical in operation, but unlike them it has been designed not as a complete instrument in itself but rather as an adjunct to the piano and to be played simultaneously with it The Solovox consists of a keyboard with 36 keys, about one half the size of piano keys, which is attached by thumb-screws just below the piano keyboard, and a slim tone cabinet containing the necessary electrical equipment which is mounted underneath a grand plano or set alongside an upright piano The Solovox keyboard is attached to the right end of the piano so that the player can span both the Solovox and piano keyboards with his

animals ranging from tiny shrimp to giant octopuses, suggests Dr Claude E. ZoBell of the Scripps Institution of Oceanography at La-Jolla. California.

Jolia, california.

Bacteria swarm in the depths in simply incredible numbers, Dr. Zo-Bell states A quart of ocean water may contain anywhere from 100,-000 to 10,000,000 bacteria, consuming oxygen at the rate of John Continues of the continues

Oxygen consumption becomes.a

MISCELLANY-

particularly acute problem at great depths, for the only way this lifegas can get down there is to diffuse slowly from the surface-with bacteria and other living things snatching greedily at it all the way down. This dearth of oxygen may be an important factor in the paucity of life in the great abvases.

GLARELESS

Student's Light Makes

Use of Polaroid

POLAROID is now available for the first time in a popularly priced study lamp that promises to be the modern successor to the old-fash-

ioned "gooseneck" lamp Advantages of glare-free light are many. Black type may actually



disappear from a white printed page under certain glare conditions But even under the most severe glare condition, it was determined that the proper introduction of Polaroid sheeting in the light path dissipates the undesirable glare element and restores the print-topaper contrast that is necessary for effortless seeing

FOREST GAME

Many Game Birds Thrive In Forests

APPROXIMATELY 66 percent of the food of all birds consists of insects A large number of song birds are the principal consumers of insects Many of these birds feed almost entirely upon this sort of food Game birds also take a great many insects, the young chicks more than the older birds. This is of particular importance from the viewpoint of sportsmen.

A recent study made at Massachusetts State College shows that the alder-bottom forest floor pro-

DEATH SENTENCE

for Dirt by Westinghouse



- · Several years ago one of the most interesting experimental devices in our research laboratory was one that acted like a magnet on smoke, dust and dirt in the air. Strange part about this electric device was that it worked just as quietly and free from moving parts as a storage battery. Yet in practically no time at all it would collect a jar full of dirt from air you'd declare was clean and pure.
- · Today, that device is known as the Precipitron* and we're having a busy time filling orders for it. That's easy to understand once you appreciate that the great American smoke problem alone costs busipess, home owners and taxpavers millions of dollars each year. But smoke is only one of innumerable air-borne impurities such as dust, dirt, pollen and other substances.
- · The way the Precipitron rids the air of smoke is an interesting example of its practical efficiency and

- usefulness. Smoke is made up of particles so minute that a screen fine enough to catch them would not allow air to pass.
- · Yet the Precipitron takes smoke out of the air as if by magic. The principle employed is simple. Every incoming particle of smoke, dust, dirt, and pollen receives a positive electrical charge. Then a negatively charged plate, acting like a magnet on steel filings, draws these particles out of the air stream.
- · We knew that there was a need for the Precipitron, but we hardly expected it would find so many uses as to open up an entirely new industry for us.
- · For instance, in textile mills the Precipitron is removing smoke and soot from the air for the dryer and spinning rooms. In telephone exchanges it is protecting the tiny, delicate relays that operate the dial telephone system. In steel mills it is cleaning the ventilating air for maindrive motors and motor generator sets. In hospitals it is safe-guarding recovery wards and operating rooms.
- · In all buildings where installed, it is reducing cleaning and redecorating costs. One store which used to repaint every year now finds it need do so only once every three years. Displays stay fresher; merchandise retains its original salesappeal. Food-processing plants, chemical and testing laboratories find the Precipitron invaluable. Night clubs now boast of having cleaner air than that outside.
- · Right now Westinghouse Research Engineers are working on many other difficult projects. We hope a lot of things like the Precipitron will result.

*Registered Trademark



There is only one "Waldorf"

Its towers, sharply etched against the sky, are modern as tomorrow...yet its tradition of hospitality goes back to a grand and spacious age.

Its glamorous restaurants, favorite gathering-places of metropolitan society, are vibrant with music and gaiety... while above, its rooms are star-quiet in the night, peaceful as the hills of home.

Its guests include the great ones of a busy world... and the quiet, unassuming people who make that world go round.



THE

WALDORF-ASTORIA

PARK AVENUE . 49TH TO SOTH . NEW YORK

MISCELLANY...

duces the greatest number of insects and spiders which game will eat. The second most productive source of large insects, suitable for game food, is the white-pine-hardwood forest type. But the greatest total of insects, regardless of their usefulness as game food, was found on the forest floor of the hemlockpine type.

There are many kinds of game which thrive in the forest, and the forest is always justified, from a sportsman's viewpoint, not only as cover for wild life but because of the beneficial effect it has on watersheds, and consequently the favorable influence upon fish life

SCRATCHLESS

Synthetic Rubber

Gasoline Nozzle

AUTOMOBILE owners who have had their cars scratched by the brass nozzles of filling station gasoline hoses will welcome adoption of a



Rubber protects the car finish

new nozzle made of Goodrich synthetic rubber This nozzle, shown in the accompanying illustration, is the first such nozzle to be listed by the Underwriters' Laboratories. Inc., and is the product of several years of research

NOT DAFFY

"Condition" Animals to Fear One-String Fences

A SINGLE string, hung between slender posts, may be enough to keep the cow of the future in her pasture if cows are psychologically conditioned. The conditioning would only mean punishing the animal with a mild electric shock

every time she went near the string Even a cow soon learns to stay away from all strings after that.

Psychology could thus save the farmer the enormous costs of iron fences and electric devices now med. Dr. A. I Gates of Teachers College, Columbia University, recently told the Educational Section of the American Association for Applied Psychology, "Although a farmer neighbor of mine declared this was a daffy idea, it is good psychology," declared Dr Gates —Science Service

IIG-SAW

Hand-Operated, Inexpensive,

Fast Cutting

A NEW jig-saw, put on the market by Dremel Manufacturing Company, is a hand tool which uses less electricity than a 75-watt lamp



Vibrating fig-saw

bulb, runs at a speed of 7200 strokes per minute, will cut through ordinary plywood at the rate of a foot forward per minute, and cuts so smoothly that no sanding is required These details sum up the important features of the new Moto-Saw The device weighs only 17 ounces, operates on 110-120 volt alternating current, and is priced at less than five dollars.

The illustration shows the ease with which this machine is handled Above the hand grip is the vibrating mechanism which holds one end of the saw blade. The upper end

of the blade is gripped at the end of a spring arm, mounted on a

ALWAYS BUSY?

Bees Take Life Easy When Food is Scarce

By an ingenious device that relieves bees of their pollen loads while permitting free passage into and out of the hive, entomologists in California have compiled records that cast doubt on the familiar idea of the inveterate industry of these insects. When a bee is "as busy as a bee" she is that way because abundant food supplies are available for harvest. But when dearth occurs, she takes life easier and does not bring home much pollen, either for immediate use or to mix with honey for storage as bee hread

WEARLESS WASHER

A www snap-on washer eliminates leaky-faucet trouble Made of rubber composition, it is so made that it does not turn and wear itself out against the seat. Furthermore, it is replaceable without a screw driver, as it simply snaps in place with the fingers.

This inexpensive new washer comes with a special screw having a grooved head, and a thin brass washer. The entire unit sells for ten cents retail, and replacement washers are but five cents.

In installing this device, the standard washer screw is removed and the grooved-headed one inserted tightly Over this is first dropped the brass washer, then the rubber washer is snapped over the grooved head of the screw The opening in the rubber washer is recessed so that a ridge moves freely in the groove of the screw-head

When the faucet handle is turned, the entire unit revolves, but as soon



Wearless washer installed, and details of parts



U. S. HAVY
SHIP'S GLOCK
"Both-Themas"

§ Dep
Slivered Dial 7" diameter, polished brass
tase, non-strike, use
but in good condition
Limited amount.

"New" Seth Thomas 20-hour Striking \$16.00

32' long 2" dia Gade in France
31' long 2" dia Optical equipment 1½" prism
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F L. Ramsden erepiece stand 1½" dia 515.00'
U.S. ARMY LIQUID COMPASS (5perty)
Bronne fewel bearing Leather case
22" diameter, 1½" high

Electric Blowers (Ventilators)
30 cu ft Min
24' intek 2" k 2"
outlet Ke
cast aluminum housing 57 ss
Cast iron housing 6 so
Available in 6, 12 33,
10 voil do 110 v a c

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as the rubber touches the seat it holds steady while there is slip between the thin brass washer and the rotating valve stem.

This ingenious new device is patented and is the product of No-Pans Washer Company.

WORLD CLOCK

Time Throughout World

At a Glance

Ar both the Golden Gate International Exposition and The New York World's Fair, the International Business Machines Corporation exhibited first models of a unique clock which may find use in arrline depols, in steamship offices, and in many other locations where there is need for, or curiosity about, the time in all parts of the world This clock, of comparatively large size, is to be mounted on the wall, and consists of a projected map of the world marked off vertically in hourly time divisions.

The map itself is immovable, but a black band lettered for hourly divisions of the day moves across the top of the map Above this moving time strip is a spot in which minutes are indicated by numerals Reference to the accompanying illustration will best indicate the simple method of reading the time for any part of the world. It will be noted that the time band has moved to a point showing that New York, for example, is in the 2 00 P. M. range The 58 minutes indicated above the strip give the exact time in New York as 2 58 P M. To the right, England and a large part of Europe are in the 7:00 P. M range; hence the time in England is 7 58 P M.

Similarly, the time in any other range throughout the world may be instantly read by looking upward from the geographical point to the time indicated on the time band and the number of elapsed minutes shown above that. One other point to note is that lights behind the map itself follow the movement of the band at exactly 12:00, Noon, so that one gets a sense of the sun spreading over that portion of the earth at that particular time and shading into dawn at the left and twilght at the right.

This clock is a development of Miss Maud M Clough, and will be manufactured by International Business Machines Corporation.

BIBLICAL SCIENCE

Jeremiah Made Scientific

Observation

*YeA, the hind also calved in the field, and forsook it, because there was no grass

"And the wild asses did stand in the high places, they snuffed up the wind like dragons, their eyes did fail, because there was no grass" —Jeremiah 14. 5 and 6

Thus sail ong one as biblical tumes the observations was made that when there is no grass on which animals may feed, one of the first and most characteristic symptoms is that of blundness Today we know that grass and all green growing plants contain a yellow pigment, carotene, the precursor of Vitamin A, which, when absent from the ration of all animals, produces as one of its most specific symptoms, xerophthalmin, or blundness, prevalent in humans as might-blundness.

And even today, when scientists wish to determine the minimum vitamin A requirements of farm and domestic animals, no better technique is available than a deter-



Time to the minute, in any part of the world



Checking field distribution of new type of television antenna

mination of that minimum amount of vitamin A value which is just necessary to prevent the onset of night blindness

Today the poultry- and cattleman can easily and quickly obtain a carotene assay of the feed he is to buy Most feed manufacturers determine carotene as a routine practice in their laboratories and thus are able to protect themselves and their customers

TELEVISION ANTENNA

With experimental work in television transmission progressing steadily and new methods being adopted in the endeavor to increase efficiency and service area, the accompanying illustration takes on added interest. It shows a part of the conical television antenna recently erected at the General Electric Company, Helderberg Station WZXB near Schenectady.

In the photograph, one of the engineers of this station is exploring the field distribution of the antenna, using the well-known closed loop and radio frequency meter set-up.

FOR CLOSE WORK

Lens and Lamps For Precision Work

ir you have ever—and you probably have often—rigged up a strong light in connection with a large magnifying lens to do some close, fussy job, maybe you thought somebody ought to develop such a thing in finished, ideal form and manufacture it This is what the Boyer - Campbell Company has done It is a bracket with clamp to



Combination lens and lamp

attach to a chair or other support, case containing lens and light. The one shown is for doctors and hospitals; a similar one for shop use or precision jobs has been developed.

MECHANICAL MEMO

Exping memo sheets on a desk so they will always be handy yet not violate the executive's demand for neatness is a problem that has now



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Turning the roller on this new memo case delivers one sheet

been solved by a new device-Rolodex, a "touch control" memo sheet case Molded of Bakelite, it completely encloses over 200 sizeable sheets

Near the front, on the top of the case, is a plastic roller Underneath is the pack of loose memo sheets. When one is wanted, the fingers touch the top of the roller and, as they are drawn forward, the revolving roller brings out the desired sheet, right to your fingers

SANITARY

Woven Plastic Seats Are

Attractive, Clean

MORE and more, plastics are moving in on us-replacing products which, despite certain disadvantages, have been with us for generations The latest move of this nature is into rapid transit vehicles to replace woven seat covers

An accompanying illustration shows the seats in a New York subway car covered with Saran, a new woven plastic "fabric" Such seats. will be more sanitary and will not split and require replacement so often as do the present woven rattan splits.

END NUISANCE

Digthermy Apparatus Need Not Bother Radio

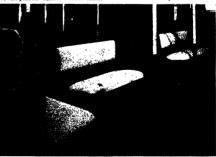
T RANSMISSIONS from electro-medical apparatus have actually been received across the continent and even across oceans When diathermy interference first began to be serious a number of years ago. the disturbances were first attributed to stations operated by persons under the jurisdiction of foreign governments. Then the signals were traced to diathermy machines operated in medical centers and offices of private physicians

Diathermy apparatus affects radio reception because the machines are essentially radio transmitters The radiation that causes interference is not essential for therapeutic purposes and steps are being taken to prevent such radiation

SYNTHETIC WOMAN?

The Chemist Can Clothe Her Cap a Pie

WE have long threatened to write someday an article on the synthetic woman-pardon us, the syntheticclothed woman Indeed, women are not only discovering that more and more of their garments and adornments are made of synthetics, but that these modern products of the



Woven plastic seat covers are sanitary, clean, durable

SCIENTIFIC AMERICAN · NOVEMBER 1949



Celulose plastics add attractiveness to shoes, belt, bracelet

chemical laboratory are in some ways more attractive than would be the same articles made of natural products We present, as an example, an accompanying photograph from Monsanto Chemical Company showing new accessories for evening wear. Attractive enough on the printed page, these articles, which are woven and crocheted in intricate designs, give the effect of simulating lewels. Furthermore, the material of which they are made is tough, strong, and resistant to water, so that only a damp cloth is needed for cleaning

ANTI-AIRCRAFT

90-MM Gun, Now Standard.

Is Effective Weapon

The new 90-mm anti-aircraft gun is now a standard anti-aircraft weapon for the Coast Artillery Its rôle will be essentially that of the present standard 3-inch anti-aircraft gun, M2A2, which it will replace insofar as future procurement is concerned. However, all serviceable 3-inch anti-aircraft guns, including those now under manufacture, still are classed as standard and are to be continued in service. For the present, technical details of the new weapon will remain in a restricted category.

According to the Coast Artillery Journal, the gun will be known as the 90-mm anti-aircraft gun, M1, on 90-mm anti-aircraft mount, M1. Although its developed rate of fire probably will be slightly less than that of the 3-inch, its projectile is considerably heavier; hence in over-all effectiveness-number of effective fragments per unit of time-the 90-mm represents a

considerable improvement over the standard 3-inch weapon The projectile of the new gun also has a shorter time of flight than that of the 3-inch for corresponding ranges and consequently a greater maximum useful range. In over-all weight and in tactical mobility the two weapons are approximately equal -- Army Ordnance

PAPER DRILL

Punches Many Sheets At One Stroke

In collating all manner of office records, it is frequently necessary for an employee to use an ordinary paper punch, go through the complicated business of measuring a few sheets at a time, and then punching by hand the holes that are to fit the material into a binder Even the larger, desk-type paper punches are often difficult to handle and do not punch accurately Christie-Lucas, Inc., has solved all these problems which can so often become major headaches, by developing a desk-type punch called the "Bull's Eye" paper drill

This machine is actually a drill. it takes up to a one-inch stack of paper at one time, and will drill up to seven predetermined registered



holes without removing the paper from the tray Despite this high efficiency, it is hand-operated and, therefore, may be moved to any location where it will find use for drilling manifests, sales bulletins. loose-leaf catalogs, and general correspondence.

Holes from 1/4-inch diameter up to and including %s of an inch diameter can be drilled with this machine. Holes may be located from one-fourth of an inch to 11/6 inches from the edge of a sheet. The leverage is six to one, and the manufacturer claims that any girl can operate it for hours with little fatigue.

FOR THE EXPERIMENTER

MICROSCOPY

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Ideal because it fits almost every instrument Colors appear with utmost perfection because practically complete extinction of light is obtainable This new polarizing medium is in use at Universities and Commercial Laboratories Type E and BT Analyzer

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Telling Stories With Your Movie Camera

HE motion picture camera is the THE motion picture cannot be story-teller par excellence in photography. The movie reel is the verbatim report of life's incidents bringing to the screen as near an approximation of what we saw-and, in these days of amateur sound outfits, what we hear-as it is possible to achieve by means today available. The chief characteristic of the movies is motion We take movies for that reason because it allows us to show a complete sequence of movements as when photographing a child at play or, by the stop-motion method, such subjects as flowering blossoms But movement of itself is not sufficient The movement must be significant, provide a living reproduction of something worth while, a subject in which movement is essential Therefore, unless movement contributes to the objective of making the subject almost literally "come to life" on the screen, you may just as well take that particular subject with your still camera

And that brings us to an inevitable comparison, odious though comparisons may be, between the results achieved with the still and the movie camera. Neither really competes with the other because each has its definite place The still camera intends to and does catch but one instantaneous phase of a subject. Sometimes it makes as many as perhaps a dozen separate impressions of the subject and calls the group of pictures a story-telling sequence or series. Within the limits of the still camera it aims to accomplish what the movie camera does, but without motion. However fine the result, such a sequence or series can be nothing more than a group of individual stills or photographs of the same subject taken at intervals. The story may be com-

plete within the limitations of the medium, but can never really be complete unless motion is introduced. to merge one still shot with another by the natural movements of the subject in changing from one position to the succeeding one.

The objective in all movie-making is the projection screen. In shooting watchword, as it should be, let us try



Figure 2



Figure 1

Figure 3



Figure 4

to visualize at the same time what the results will be when projected Will our audience be bored because the scenes are too long or disappointed because the scenes are skimpy and therefore too brief to provide the impression or tell the provide the impression or tell the story you thought you were shooting? Both faults should be avoided. In the first case, "splicing" in advance, that is, before shooting, is the best way, though some judgment and experience is admittedly required. The more splicing you do in avoiding insignificant and plus footage, the less you will have to do on the splicing block. On the other hand, if the scene is too brief it will be on and off the screen before your audience has had a chance to get any impression of it at all. Clipped scenes are probably the worst bugaboo of all for the stall man who turns to movies for the first time. One of his first goals, therefore, though it is not too difficult to reach. is to battle and conquer the instinc-

tive desire to short-change his scenes. Concentration on significant movement is frequently accomplished by selecting an individual subject out of a group and shooting away at that until you have exhausted its possibilities. In Figure 1, we show a group of artist students painting a model on the heach at Provincetown. As a group, it was cinematically unworthy of more than brief notice—just long enough to show the group and allow the eye to get an impression of the general scene But a look around will usually discover some one subject that holds promise of interesting movement. This we found in Figures 2 and 3 The young lady in question had grace, movement, and now and then struck attitudes somewhat flav-

ored with humor The tiny fisherman made another good subject with the difficulties he was having keeping his fishing line untangled A scene like this would make an attractive bit in a longer reel of other doings on the same wharf

Sound Movies

DEVELOPMENTS in the sound-movie equipment first described in Scientific American for December, 1939, have brought it to a high state of perfection and flexibility available equipment you can make talking pictures at home, pictures as lifelike as those you see in the theater You can photograph your family or friends, singing, dancing, performing dramatic sketches You can take close-ups of dialogue The voices will



rosound drive. Below. Turn-ole unit, five-minute disk



f 3.5 \ WITH

for a victure together (C)-and 6 ou're in exact focus orings both halves

natic shutter setting, Eastman Kodak Anastremat special // 3.5. Shutter, 1/200econd Kodamatic. Doublexposure prevention, autoprecision construction. Price, auth neck strap, \$47.50 seautifully sharp picture. Lens,

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our subject split in two, norizontally . . . the lower ou focus simply, swiftly, urely. Looking through the ange finder window, you see 4 above) -or to the left (B).

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Fifth Annual Scientific American AMATEUR PHOTOGRAPHY CONTEST

OVER \$1200 IN PRIZEC IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules In addition to the seven major prizes and five honorable mentions, there will be three SPE-CIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. These special awards will be owen in addition to the regular prizes that the pictures win

36 PRIZES DIIIS Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on Portraits will be grouped in this division Division 2 Landscapes, including all scenic views, seascapes, and so on

Division 3 Action, including all types of photographs in which action is the predominating feature.

IN EACH OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS.

RULES of the CONTEST

- The groups will be judged indeappeal and technical excellence The decision of the judges will be
- The decision of the judges will be final In case of a tie for any prize.

 the typing contestants

 the typing contestants

 by 7 or larger than 11 by 14 inches
 All prints must be mounted, otherwise they will be returned immediately

 Photographs must be packed properly to protect them during trans-
- portation
- ion-winning entries will be re-turned only if sufficient postage is included when the prints are submitted
- mitted
 5 Each entry must have the following data written on the back of the mount Name and address of contestant, type of camera, and film,
- enlarger, and paper used

 6 Contestants may submit no more
 than two prints in each group, but
 may enter any or all groups In no
 case, however, will more than one ward be given to any individual
- 7 Prints must be in black and white
- 7 Prints must be in black and white.
 Color photographs are not eligible
 8 Prize-winning photographs will become the property of Scientific
 American, to be used in any manner at the discretion of the pub-
- 9 Scientific American reserves the right to purchase, at regular rates any non-winning entry
- 10 No entries will be considered from
- No entries will be considered from professional photographers
 All entries in this contest must be in the hands of the judges by December 2, 1940 Results will be announced in our issue dated Febnounced.
- rusry, 1941
 12 The contest is open to all residents
 of the Western Hemisphere who
 are not in the employ of Scientific American
- American

 In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification

THE PRIZES

Watches.

sentation Model, Solid Gold, Men's \$19,75). Wrist Watches.

1st. Three \$125 LONGINES, Corona- 4th, Three FEBERAL No. 345 tion Model. Solid Gold, Men's Wrist Photo Enlargers (List Price \$42.50).

5th. Three PIERCE CHROMOCRAPH 2nd. Three \$85 LONGINES. Pre- Man's Wrist Watches (List Price)

6th. Three BERMAN-MEYERS Flash 3rd. Three FEDERAL No. 248 Guns complete with case (List Photo Enlargers (List Price \$49.50). price \$15).

> 7th. Three FINK-ROSELIEVE Vanorators (List price \$12.50)

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1st. Three Fink-Roselieve "Hi-Spot" 4th. Three Fink-Roselieve Audible Hollywood type spotlights.

2nd, Three Mimosa Perkino devel- 5th, Three Fink-Roselieve Satinoping tanks.

3rd. Three Raygram Wood-Chrome Tripods.

Timers.

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THREE SPECIAL AWARDS I

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price \$24.) 2nd. One No. 650 Weston Exposure Meter (List price \$19.95.) 3rd. One No. 850 Weston Exposure Meter (List price \$15.50.)

THE JUDGES

McClelland Barclay, artist T J Maloney, editor of U.S. Cam Ivan Dmitri, artist and photographer Robert Yarnall Richie, photographer

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silent speed, 16 frames per second, saving one third of the cost of sound-film productions

In addition to their low cost, disk recordings have several advantages over film recordings for home, educational, and experimental uses The sound reproduction from the disk recordings is equal to the best sound-on-film Each sound recording can be played back immediately after it is recorded for checking purposes The records can be edited to match the final edited film. With synchronized disk recordings you can add sound to colored pictures without printing The original prevents film may be used

These advances in home movie making are made possible by the Syncrosound System which enables you to combine home movies with home recordings Synchronization between the disk and film is assured by a fool-proof mechanical and electrical locking system

To make and project talking pictures, you will need, in addition to your camera and projector, a portable sound recorder and three Syncrosound units—one for the recorder, one for the camera, and the third for the projector. The turntable unit is equipped with a bracket and mounting post so that it can be mounted on any recorder, home phonograph, or record player by means of one screft the camera drive unit is designed so that the tipod errew and one brader throat together.

Syncrosound units are now available for Ampro projectors, Bell & Howell 8mm and 18mm cameras and projectors, Bolex cameras, Keystone 8mm camera and projector, and the Victor 18mm camera and projector. Units can be supplied for other makes on special order.

Use the Large Stops

When making enlargements, it is Wgenerally preferable to use the larger stops. Some workers automatically stop all the way down as a matter of course, after having focused with the lens wide open. The only times it is really necessary to use the

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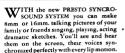
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make and reproduce high fidelity synchronized recordings. The model K (illustrated) makes records that play 5 minutes. The Presto model Y 16" recorder makes records that play 15 minutes continuously, sound for a complete 400" reel of 16mm. film.



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To make and show talking pictures you need a Presto recorder and 3 SYNCRO-SOUND attachments, one for the recorder, one for your silent projector and the electric drive for your camera. To show silent pictures with post-recorded narrature you need only the projector attachment and the transable attachment which can be used on any home phonographic dealers and recording studios are being equipped to make synchronized records for you.

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....CAMERA ANGLES.

smaller stops is when the film plane in a faulty enlarger is not quite parallel to that of the baseboard—in which case you should have something done about the matter anyway—and when projecting on a titled essel as when correcting for distortion. At the very small stops, there is the danger of picking up the grain of a ground-glass diffuser, causing scattered light to cut down the contrast of the print, and unsharp pictures due to vibration during the relatively long exposures necessary at the small stops.

When is a Candid Shot?

PROBABLY you won't believe it, but this is not a posed picture in the usual sense of the term, although it surely does look like one. The gen-



"Camera Fan"

tleman was intently studying the picture possibilities in a group of fishing boats, when we came along and made our picture. This was a rather easy one because the subject was absorbed in thought.

Lamp for Ultra-Speed

A STUNT of the laboratory has become the useful tool of the working photographer in Eastman Kodak Company's adaptation to general uses of the lamp employed for high-speed photography by Dr. Harold E. Edgerton and his associates of the Massachusetts Institute of Technology. The unit is known as the Kodatron Speedlamp and employs a gas-filled, elec-trically-operated flash tube, providing an effective flash speed of about 1/30,000 of a second. This speed has been found to be adequate to stop virtually any moving subject except a rifle bullet. Although the speed of the flash could be boosted to 1/1.000 .-000 of a second, light volume would be cut down correspondingly.

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CAMERA ANGLES ---

1/80,000th second speed is, of course, many times faster than the highest setting of any camera: about 800 times as swift as the wink of an eve. and about ten times as fast as is necessary to stop an athlete in action. The tube yields more than 5000 flashes, after which it is replaced with a new tube One flash can be made every 10 seconds, the charging time of the condenser.

"The Kodatron flash is accom-plished," write the manufacturers, by discharging a condenser through



Kodatron Speedlamp

a gas-filled tube. Ordinary 110-volt, 60-cycle current is led into the power unit of the lamp, where a speciallyconstructed transformer steps it up to 2000 volts. This current is then rectified and used to charge a condenser when the trip circuit is closed (manually, by a flash synchronizer, or by the photocell unit), the energy stored in the condenser is the energy stored in the condenser is discharged through the tube in ap-proximately 1/30,000 of a second, producing a flash of high photo-graphic efficiency."

The flash lamp itself has a tubular frosted glass shell, fitting over a spiral glass tube which contains a mixture of krypton and xenon gases This is the flash element, the gas heating to incandescence when the condenser charge is released through it Centered in the coil of the gas tube is the modeling or focusing light so that the angle of lighting is the same for both flash and modeling light The modeling light is a V-filement projection type bulb of moderate wattage and long life

Why Retouch?

BRIEF for retouching as a matter of prime necessity, if successful portraiture is the goal, was recently put forth by J. Ghislain Lootens, F.R.P.S.

"If you are interested in portraiture you are going to retouch or be disliked by your friends," writes Mr. teacher of photography as well as one

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of our ace pictorialists "Of course, if you're a professional you don't even expect to take portraits without some retouching-that is, if you intend to stay in business.

"Experience has taught that there is no system of lighting or type of film that will consistently give pleasing pictures of all sitters We, therefore, don't retouch for the fun of it—it's a

prime necessity

The average amateur buys a book or magazine illustrating the so-called secrets of lighting and faithfully measures the correct distance between his sitter and lights. He even uses the same equipment as the maestro, but his own pictures are simply terrible Why? Unquestionably he has been trying to imitate a portrait that was beautifully retouched, but no mention was made of that fact

"My advice would be Study good portrait lighting, of course, but don't forget that retouching goes with it."

THE ROUND TABLE

Questions Answered for

the Amateur Photographer O I have heard that one can snot

glossy prints by using graphite dust. How is this graphite mixed?—H. M. M. A. The graphite is simply shaved off an ordinary lead pencil, the regular spotting brush moistened and a little of the graphite picked up on the end of the brush, which is first formed with the fingers to a point Slightly work the graphite into the point of the brush using a piece of paper as a palette and then apply to print a little at a time. It is best to apply retouching dope to the area to be spotted A retouching pencil or spotting color on a brush may also be used.

Q. Directors of photography for motion pictures carry the title A.S.C. Will you please tell me the meaning of the above letters?—H. H.

A. These initials stand for American Society of Cinematographers and indicate membership in that society

O I have trouble with drying marks on my negatives. Can you offer a remedy?-D. G.

A. Make up a solution of 1 ounce Sodium carbonate

Water 10 ounces Place the negative in the solution and warm the latter to 90 degrees, Fahrenheit. Cool the solution to 68 degrees and rinse the negative in water at 60 degrees. Now place the negative in a hardening bath, wash and dry

Q. Is there some convenient method making enlargements without white borders?-D. L.

A. Every worker who desires borderless prints has his own way of achieving this end. One way is to cut five-ply board with dimensions about an inch larger each way than the

largest picture you intend to make; for example, 9 by 11 inches for 8 by 10 prints. Center the paper on this board; at each corner drive an insulating staple, allowing it to project just far enough to permit slipping the corner of the paper in and out. For focusing the image, the 8 by 10 area may be painted white or you can use a sheet of thin cardboard or paper cut to the exact dimensions of the paper to be printed.

Q Is there a remedy for bringing back to life negatives that have be-come dry and brittle?—S. C. A. There is available a formula for

conditioning negatives that has given satisfactory results in many instances Here it is 1 dram Camphor 1 dram Menthol

Oil eucalyptus 2 drams Glycerin 4 ounces

Q. Will you please suggest a method for removing developer stain from negatives?-R. A. L. A The negative is first bleached in

the following solution Potassium permanganate . 50 grains Table salt 1/4 ounce Glacial acetic acid 1 ounce Water to make 20 ounces After bleaching, rinse the negative in plain water, then place in Potassium metabisulphite 1 ounce 20 ounces Water to make Leave it in this bath until the image turns white, then redevelop the negative in any non-staining developer

WHAT'S NEW

In Photographic Equipment

ANNIVERSARY ENLARGER GRAFLEX (\$87.50, including one negative carrier, but without lens) . Condensertype enlarger for negatives up to 21/4" by 31/4". Features "variographaltering of linear perspective Features "variography." means of two-way tilt of negative. tilting lamphouse, and accessory universal-tilting easel holder. Tripodtype column furnishes two anchor points for arm carrying head. Rear leg of column serves as guide for counterweight and as conduit to keep waterproof lamp cord out of way Baseboard 24 by 32 inches, leveling foot at right rear corner. Head supported near center of balance and counterbalanced by weight on other end of cable that runs over wheel at top of column. Negative triple-cooled by circulation of air, by radiation of heat from deep fins on lamphouse, by isolation from any direct metal path by which heat of lamp might reach it Double condensers in basket-type cerrier that beyonet-locks in position can be replaced by diffusing screen for soft light to lower contrast of print or conceal negative blemishes. ensboard bracket accepts Miniature Speed Graphic lensboard. Negative carrier can be used with or without glass. Head comes off to mount

----CAMERA ANGLES-

camera on arm for copying, macrophotography, or photomicrography; Graflex, Speed Graphe, Graflex Photorecord Microfilm Camera, or any other may be used, as well as movie cameras for tilting and other closes in work

Warson 5x7 Potraait Cames, (\$20.50): Adjustable with reducing backs from 2x₀ by 3k₁ to 5 by 7 Features Tiging, swinging lens board and the state of the state

SPEEREK JUNIOR CAMERA (\$11) Employs same design, styling and construction as original Speedex, with body shutter release, centrally-located optical eye-level finder, rapid opening, precision movement of front platform; and hinged back with safety latch Fitted with fixed-focus, four-latch Fitted with fixed-focus, four-state fixed with fixed-focus, four-state fixed with fixed-focus, four-state fixed with safety fixed f

PRINCETON MOLDED TENITE SUNSHADE AND FILTER HOLDERS (\$1) Available in four sizes Lens barrel—21-29mm, 31-39mm, 34-42mm, 37-45mm, Filter diameter—315mm, 39mm, 42mm Size 34-42mm sunshade designed for Leica and Contax cameras American made

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ESSENKAY COLOR FILM ADAPTER (\$4.50 to \$6, depending on camera) Permits use of Bantam Kodachrome rolls in roll-film cameras taking Eastman 120 or Agfa B-2 film Adapter installed or removed quickly uickly No Made to special holes required couple with automatic film stop and film counting devices on cameras. At present available for following cameras (numerals designate number of exposures per roll of Bantam Kodachrome) Automatic Rolleiflex, 9; Super Ikonta B, 9; Rolleicord, 10, Argoflex, 8; Altiflex, 8; Wirginflex, 8, Korelle Reflex, 10; Ikoflex I, 8; Ikoflex II. 10.

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sticks. Illustrated booklet includes
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solves individual feature problems

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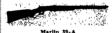
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INTEREST IN FIREARMS is traditional with American men; fishing backle is a requisite of one of the world's oldest occupations. Scientific development of puns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly denorment which welcomes correspondence from readers.

Mountaineers Test Marlin

ME've just subjected one of Marlin Firearms Company's new, rede-signed Model 39-A lever action .22caliber repeating rifles to about the toughest test we can conceive of The Marlin 39-A, you know, is the only lever action repeating .22 in the world, and it's endowed with the same simplicity of breech action and construction that helped make John Marlin's name famous over 49 years ago (See May, 1940 issue) Latest refinements on this sweet shooting little gun include redesigned receiver. shortened tangs to permit remodeling of buttstock and to allow the comb to be moved farther forward Coil main and trigger springs have replaced the flat steel type, producing smoother and easier working action.

We took this Marlin 39-A into the mountains of West Virginia, where the present generation of gunners are direct descendants of some of the straightest shooting rifle shots that country ever knew Many things in the Mountain State have changed since the time of the great-greatsince the time of the great-greatthe West Virginian's demands on a rifle, small calleber or large, are just



as stringent now as they were when accuracy and speed of operation meant preservation of life. The gun must feel right, sight quickly and truly, shoot straight and hard, and if you think the present day mountainer doesn't recognize "oomph" in

a rifle when he sees it, you're sadly mistaken.

When the boys in the Mountain State try out a new rife, they don't bother with such prosaic things as Army L targets or any other kind They, like their fore-fathers, are shown that they are the state of the state

No, they do it this way. They cut a piece of white paper about two



Mitchell and "Ol' Yella Jacket"

inches square and peg it with four whittled pegs to a block of stove wood, which preferably has been darkened by weather They pace off 60 yards and lay a log on the ground at right angles to the course of fire. Stretched prone behind the log, they rest the front of the gun barrel on the log, but-and this is importantthey do not support the fore-end of the gun with the left hand as we 'civilized" target shooters do. They bring the left hand back so it can grasp the bottom corner of the buttstock where it projects slightly below the shoulder The right hand takes the normal trigger position, but the left steadies the gun and prevents canting to left or right.

The results? Three West Virginians, none of whom had ever seen this Marlin before, each fired five shots (.22 long-rifle cartridges) at the target from the prone position. Of the total of 15 shots, 9 were well within the square of paper, two clipped the edges and the remaining four were in the wooden block, just off the paper's edge. The performance was repeated by three more shooters at the same range and this time only two shots missed the paper. The verdict? That portion of West Virginia's male population which did the shooting, as well as the onlookers, ungrudgingly and enthusiastically voted this new Model 39-A Marlin to be one of the best shooting rifles it had ever seen

Said Hugh Mitchell, one of the best of the marksmen, and a man to be feared in any shooting competition, "'Deed, Ah reckon this little gun is about the micest shootin' rifle I've handled since my granddaddy gave me Ol' Yella Jacket." And by way of explanation, "Ol' Yella Jacket" is a 91/2 pound muzzle loader with a 40octagonal barrel 3 1/16 inches in circumference, a bore of 7/18 inches, and it still shoots a lead ball straight enough to take that wild turkey's head right off from the top of his neck. During the past three generations Mitchell's "Ol' Yella Jacket" has won more shooting matches than any other rifle, antique or modern, in that section of West Virginia's mountains, so praise from Mitchell is real praise.

Outboards for Ducks

TNDER provisions of the Federal Migratory Bird Treaty Act, ducks and other migratory game birds may not be hunted from a power boat, and a boat to which an outboard motor is attached is unequivocally within that category However, like the lad in the picture, the hunter may use his Evinrude or Elto to propel his boat to hunting location, then he shoots from



Ducks . . . and outboards

the boat after the motor has been detached and placed inside the craft Obviously, he may re-attach the motor, after hunting is over, to return home. Just to be sure on this point, we asked the Fish and Wildlife Service. Department of the Interior, and have their word that the above is the correct interpretation, but by all means take that motor off the stern before you start pulling triggers, or you'll be in trouble with Uncle Sam.

Strange Guns in Strange Places ...

IN 1842, Henry Deringer, Jr., manufacturer of famous pocket pistols that bore his name, received one of the contracts to furnish the United States Army with its first percussion pistols. In Brandon, Vermont, 29 years earlier, and in Hartford County, Maryland, three years earlier, were born two men, both of whom were

destined to own famous Deringers and to bitterly oppose Abraham Lincoln.

man from Vermont was The Stephen Arnold Douglas, who ran against Lincoln in the Presidential election of 1860, and who later gave the martyred Chief Executive unfaltering support. The Deringer owned by Douglas had an engraved lock and hammer, with the word "Philadelphia" stamped on the former. On the German silver name plate, which also served as butt-strap, was engraved "S. A. Douglas." Before Stephen Douglas died in 1861, he presented his pistol to J M Tenny, then proprietor of the National Hotel, in Washington. On the 14th of April, 1865, the man from Hartford County, Maryland, carrying a Deringer identical in every way to the one formerly owned by Douglas, save for the engraving of his name, slipped into a box in Ford's Theatre, in Washington, and shot President Abraham Lincoln That man was John Wilkes Booth It's a strange coincidence that Booth should use a facsimile of the pistol which belonged to Douglas, Lincoln's opponent for the Presidency If you drop into the office of Francis Bannerman Sons, New York City, to whom we are indebted for this tale, and ask to see their extensive firearms collection. or if you'll browse through their annual "Military Goods Catalogue," you'll find many examples of "strange guns in strange places" Have you a story about "strange guns?" We'd like to hear it

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Gun Book of the Year

All too seldom in these days of mass a publication there appears a book which causes one to gasp in amazement at the author's comprehensive treatment of the subject, to exclaim an admiration at the beauty of compilation, illustrations, and binding, and to marved at the thoroughness and simplicity of presentation Substantial and the subject of presentation Substantial Properties of the subject of presentation and simplicity of presentation and Frank A Belden, who spent years in research, planning, and consultation with other eminent arms collectors and experts in preparing their work It is a magnificent publication of over 700 pages, 8 by 11 inches, containing

500 illustrations In four parts, devoted respectively to history, from earliest known guns to modern Colts, an outline of the antique and obsolete models of Colt arms and their several variations: photostatic reproduction of documents contemporaneous to manufacture of Colt arms from 1832 to 1940: and facsimiles of a number of patents on the Colt revolver, the book not only is completely indexed, with a glossary, but also is arranged with Table of Contents showing chronologically the development of the re-"A History of the Colt Revolvolver ver" will prove to be an encyclopedia for the arms collector, an invaluable correlative volume for the historian, and a source of endless enjoyment and information for the layman

Last month we mentioned our compilations of books reviewed during the past year. There are four of these lists, covering publications in the fields of firearms, fishing tackle, gun collecting, and natural history, and the only cost is a 3-cent stamp for return postage.

Insurance for Fishing Tackle

OMES now the time when anglers omes now the time when any poignant memories, store away their tackle for the winter. The more care given to rods, reels, lines, lures, and boots when the frost is on the pumpkin, the better condition the gear will be in when ice goes out next spring and the first timed buds and hards arbutus issue their annual siren call to hibernating fishermen Hang boots heels up in a dry, cool place Check rods carefully for loose ferrules, worn guides, cracked agates, and the protective coat of varnish. If the bigone-that-got-away left you a cracked or broken section as a souvenir, send the rod to the factory that made it

To those who know how, removal of guides, windings, and worn varnish preparatory to application of the new coat and new wrannings is not a difficult fireside chore for winter evenings. In fact, it's fun and a good time to dream of new conquests, but if you've never done it, and if your's is a prized rod, it's best to trust the folks who made it Too much varnish and poorly applied windings may completely alter the rod's action Avoid excessive moisture or heat in storing rods and never leave them standing in the corner They'll come out parabolically inclined Stone either in their aluminum cases or hung up whole or in sections perpendicularly on the wall by tip and by guide

by guide
Reverse silk lines on the reels and
thoroughly clean the reels themselves,
and it's good murance to aller the
position of the clock so a new point
con's wear. Enameled trout lines
keep best off the reel, colled and hung
in large loops, preferably with support at many points, such as a 10inch tube of blotting paper Dry
leaders, wash out leader boxes and
moistening pads As to trout flees,
bass bugs, and other lures containing
delectable tid-bits relished by moths,
protect them in their cases or boxes
with particles of moth balls or other

repellents.

Winter is a good time to clean out the tackle box, sharpen up hooks on base pluss, put a drop of oil on shiny spoons to keep them that way, and generally to take inventory to see what is needed. Christmas is coming, you know, and so are 1941 catalogs from Messrs. DeWitt, Heddon, Pfluser, Mills, Shakespeare, South Bend, etc., and the seep of the seep o

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BRITISH WARSHIPS THE BOVAL

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LIFE ON OTHER WORLDS By H Spencer Jones

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A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

As the telescope making hobby continues to spread, the tendency to want permanent housings for the telescope increases; they save a lot of bother, and greatly add to comfort in cool weather W L Moore, Coral Ridge, Ky, is the maker of the one shown in Figure 1 The lower struc-



Figure 1. Moore's observatory

ture serves as a tool house. The dome above it is itself 10' in diameter and 8' high Its upper or hemispherical part is made of 28-gage sheet metal, with ribs similar to those suggested by Scanlon in "Amateur Telescope Making-Advanced" The vertical or skirt part is made of corrugated metal Contrary to first appearances, however, the two parts are permanently attached to each other, an arrangement which affords a little more headroom at the sides. This puts the rollers, which are ball bearings from junked cars, down at the level of the observing floor Moore says he can push the whole dome around with one hand Inside, at present, is an 8" reflector

Chief value of studying others' work, before undertaking one's own, lies in finding what mistakes others made and not repeating them. Asked, therefore, what, if anything, he would not do again, Moore stated that he placed his stone pier, 30" square, in the center of the dome, not realizing that if he ever wants to use a German or a fork mounting it will then be offcenter "If I built again," he points out, "I'd also make the seams in the dome a little higher I turned up 1" on one side and 1/2" on the other but I should have made these 112" and 1" respectively, so I had some trouble with leaks, having to use a lot of solder at the low places I also made the frame of my shutter, which carries its two pieces of 36" sheet metal, too light and it rubs on the dome frame, making it a bit hard to open the shutter This wooden shutter frame rides on barndoor rollers."

A fat collection of "Things I'd Never do That Way Again" would be a big practical help in amateur telescope making. Who is there who couldn't contribute a few! Open invitation

PROM Clayton F Howe, 514 Arthur Ave., Kalamazoo, Mich., comes this note "Here are photographs and a sketch (Figures 2, 3, and 4) of a turret eyeptee holder I have recently finance for the property of the pr

"The turret, made of aluminum, floats around on a thin film of oil and doesn't upset the aim of the telescope as changing eyepieces in the usual way often does. In freezing weather I plan try substituting glycerine for oil

"For convenience of representation, in the drawing, the spring-ball holder is shown opposite the large boss but, as Figure 3 shows, it actually is at one side of it. This permits the holder to be mounted nearer the main telescope tube.

"The eyepiece tubes were threaded into the turret while the whole assembly was mounted on a lathe arbor.



Figure 2: Howe's turret rig

d consequently they are absolutely pere pendicular

"I am making a couple more for local TNs I made my own patterns, and the castings from these cost me only 50 cents a set Brass tubing was two bits and the remainder came from the scrau box."

white turning over files of telescoptical items from previous years, your factor from the following the file from The Journal of the Royal Atronomical Society of Canada, Sept. 1937, in which H S McClung, of Regna, Saskatchewan, described what he calls the "corneal reflex test." Suppose, in the regular set-up for the Foucault test, that the lamp and pinhole were removed and a small ball were substituted for it, with a strong light somewhere in front but off to the light to the urvest ball would no fleet become the pinhole This, of course, has often been done; sometimes a drop of mercury is used, or a small marble of glass, or any spherical reflecting substance

The ball used by McClung, however, is the ball of the eye itself. This permits the effective light-source—that is, the reflection of the lamp on this ball-to lie very close to the knifeedge, thus avoiding astigmatism due to separation of pinhole and knifeedge. McClung says the light used should be strong but need not be very small in area This light may be a disadvantage, shining, as it would, in the eve when the latter was studying the subtle shadows on the mirror It is also hard to hold the head steady enough to conduct this test, and Mc-Clung suggests a headrest However, some may like it Have many been using it, since McClung published it?

Years ago in this department there was a note about using the edge of the pupil of the eye as the knife-edge and dispensing with the ordinary one. This, too, required considerable steadness on the part of the tester Maybe some readers will want to compound these two We don't necessarily recommend either one for regarder that the steadness of th

In This department, October, 1935, Joseph A McCarroll, of Teaneck, N J, described a penetrometer for reducing the hardness or softness characteristics of pitch to a quantita-



Figure 3 Turret. Another view

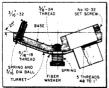


Figure 4: Section of turret

TELESCOPTICS-

tive science, and, in the October, 1936. number, two more penetrometers were described. Now comes Robert E. Smith, D D.S., Medico-Dental Bldg., Sacramento, Calif., with the one shown in Figure 5. It is made from sundry pick-me-ups, plus an optician's diopter gage to register the timedepth penetration of the point into the pitch at given temperatures. The point



Froure 5: Smith's penetrometer

is shown above two pitch facets. Using this, Dr Smith claims he knows all the time, as he works with pitch, where he is "at"

Mong amateur glass polishers you can always get up an all-night argument about the merits and demerits of various pet fine-finishing abrasives Here's a comment by D Everett Taylor, 191 Prospect St, Willimantic. Conn

"For a final step in fine grinding, before rouge, use extra fine emery in kerosene, as the grains break down easily and smoothly when so used and are much less likely to cause fine scratches?

With regard to Levigated Alumina he says, "This is a buffing flour for polishing metals and, for this purpose, it undoubtedly is tops, but when the microscope revealed that it had an extremely small grain size its use also for superfine finishing of optical surfaces was recommended |"ATM," 4th edition, pp. 296, 493 -Ed. | If you are intent on using Levigated Alumina for fining glass surfaces, watch out for fine scratches"

Taylor states also that there is a glass removal of about a thousandth of an inch, between the kind of surface left by Carbo 600 and one sufficiently fined with fine flours, to be called ready for polishing. He says also that 0.0003" of glass must be removed in order to eliminate fine scratches of the kind that require magnification in

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-TELESCOPTICS-

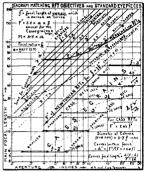


Figure 6: Walkden's matching data

order to be seen Asked how he determined this, Taylor replied that the statement is based on a measurement of a lens before and afterward, using a Starrett micrometer.

INTEREST in Walkden's Richest-Field Telescope, or "RFT," continues, and many have been made In the following contribution Walkden, whose address is 46 Cavendish Road, Harringay, London, N4, England, discusses the matching of RFT eyepieces and objectives

"If an amsteur has an objective and wonders what eyepice he needs to make it an RFT, he can get the answer from the accompanying dargarm without even a calculation; or, if he has a few eyepicees or their lenses lying around and wonders how he could use one, if possible, for an RFT, the diagram again answers without calculation.

An atural way of designing an RF1 is to start with the aperture, a", then decide on the focal ratto, c, then the focal length, "r and, finally, proceed to the eyepiece focal length, f", and the particulars of the lens But among the eyepieces available is likely to be one not exactly but only nearly what is needed, and then, taking that near; we soon find ourselves working back to the main focal length and the aperture, in a matching morces.

"Now the diagram of Figure 6 performs this matching process very quickly for every type of RFT—refractor, Newtonian, Herschelian, Cassegrainian and even Gregorian—and it also shows at a glance the various alternatives we might prefer to what we originally thought of constructing.

"Suppose, for example, we have in possession, or in makers' lists, a 1¼" RFT eyepiece. Looking at Figure 8, and at the sloping line for the 1¼" eyepiece, the eyepiece is seen satis-

factorily to complete any Newtonian RFT of from 4" to 12" aperture, the ing read on the left-hand scale where it is 4.4 times the aperture, agreeing with the formula near the top. The eyepiece can stratch over the renge of 3" to 15" or even 20" aperture, but Newtonian RFT's of less than 4 aperture are not good. being too much choked by their flats, and New-tonians of 15" and 20" aperture are better with evenieces of 1%" and 2" focal lengths and main focal lengths of 92" and 140", and even then they hardly equal large Herschelians. While con-siderable margin is allowable, especially for eyes not very sensitive to the blind spot (image of the flat) in the center of the Newtonian's Rams-

the Newtonian's Ramsiden circle, it is always as well to keep in mind that for an eyepiece of f inches local length, the best aperture under the minimum-obstructure of the control of

"If we have only the 1½" eyepiece we should not think of any other RFT than a Newtonian of moderate aprincip but suppose the RFT eyepiece is of 3" focal length. This 3" eyepiece can be seen to complée any refractor RFT of over 2½" aperture, of about the focal length to be read on the left-hand scale, 10 5 a inches, corresponding to the formula near the top. Or, paying regard to the thick Herschellan curve, the eyepiece will complete good Herschellan RFTs of about 5" to 10" or even greater apertures, all of the same focal lengths as refractors, or like the formula near the tolk the same focal lengths as refractors, or like the formula near the 10 the same focal lengths as refractors, or like the formula near the 10 the same focal lengths as refractors, or like the formula near the 10 the 10

"Should our preference be for a Cassegranian RFT, the 3' evepiece will complete any such RFT of 22' man focal length, ranging in aperture from about 5%" to 14%", chosen larger according to experience and skill in figuring mirrors of small focal ratios when aided by Kirkham's scheme of using a spheroidal small convex mirror (see Scientific American, June, 1938). The formulas in the right hand lower corner may also ald the constructor, and the peculiarly noticed, that the focal length of the eyepiece primarily determines only the focal length of the main mirror, leaving the aperture to be chosen from independent considerations.



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TELESCOPTICS-

"Should a Gregorian RFT be chosen (although it gives little reason for being liked), the 3" eyepiece will complete such an instrument, ranging from a 41/4" of 11" focal length to a 10" of 16" focal length

"In another use often required of the diagram, suppose we have already decided on 6" aperture, and have the choice of several RFT eyepieces Proceeding upward from the bottom of the diagram at 6" aperture, we can evidently have a 6" Cass RFT of 9.8" main focal length, employing an evepiece of 2" focal length And the Cass rules in the right-hand lower corner tell how the convex and the hole are both to be of 1.40" diameter, also how the convex is to be 185" within the main focal point, and be of 2 42" focal length. The alternative Cass RFTs of greater focal lengths, employing larger eyepieces, are easier to make, but they are less and less efficient.

"In 6" Gregorian RFTs we can have one of 10" main focal length, employing a 21/2" eyepiece, but it is not a very good instrument. The alternatives of longer focal lengths, employing larger evenieces, while easier to construct. are even less efficient.

"The 6" Newtonian RFT is one of 26" focal length, employing a 11/4 eyepiece, and is the useful handy kind of RFT which is perhaps the most liked, until the virtues of the Herschelians come to be further realized Again, in connection with Newtonians. the 6" mirrors can be matched by others than the recommended 114' eyepieces. The 'best' eyepiece corresponding to minimum-obstruction design is always of focal length equalling 0 45 Va inches, which is 1 10" for a 6" mirror, but the insensitiveness of some eyes to the blind spot in the Newtonian's Ramsden circle allows of considerable variation in the eveniece focal length. When f is decided upon, the mirror must always be made of focal length F = 35fg inches, and the flat be arranged according to the rule given in 'ATMA' An aperture less than 3" or even 4" should not be assumed for a Newtonian RFT-and an aperture greater than 25" perhaps need not be assumed.

"The 6" Herschelian RFTs begin to be quite good at 63" focal length, employing a 3" eyepiece, but 72" focal length, using a 31/2" eyepiece, proves better in definition. Only the fastidious might want still greater focal length employing a still larger eyepiece. It is curious to notice that the larger eyenieces go with the smaller Herschelian RFTs, contrary to the rule for the Cassegrainian and even the Newtonian RFTs."

As no 3" eyepiece is known to be available on the market, the amateur must make his own. For this, Walkden gives the following data on a Ramsden of the usual two plano-convex lenses. Focal length of each lens. Distance of lenses apart, 2.67" Diam. of field lens, 2.31", of eyelens, 1.8". Eye-hole distance suiting smallest need, 7/8". Eye-hole diam., 1/2".



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By ORSON D. MUNN, Litt.B., L.L.B., Sc.D. New York Bar Editer, Scientific American

Reissus

THE Supreme Court has held that a The Supreme Court infringement cannot be maintained against a defendant who acquired and used a machine subsequent to the granting of an original patent, which did not infringe that patent but which does infringe the claims of a reissue patent applied for subsequent to the time when the machine was acquired

In the case in question a patent was obtained on a machine for treating nuts by mixing butter therewith so as to make them more appetizing. After the patent was issued the defendant purchased and used a machine for the same purpose which did not infringe the patent Subsequent to the time that the defendant purchased the machine the patentee applied for and obtained a reissue of the original patent. The reissue patent was of broader scope than the original patent and several of the claims were infringed by the machine

acquired by the defendant The controversy arose over the charge of the patentee that the defendant's machine infringed the reissue patent The Court held that by acquiring the machine which did not infringe the original patent during the period between the granting of the original patent and the filing of the application for the reissue, the defendant had obtained intervening rights which permitted him to continue using the machine even after the time that the reissue patent was obtained The Court pointed out that when the original patent was granted it was presumed that everything not claimed therein was dedicated to the public by the patentee and that anyone had a right to rely upon this presumption Under the circumstances the patentee was held to be estopped to enforce the reissue patent against the defendant

Privacy

FEDERAL Court has recently sustained the right of a periodical to publish news articles describing the intimate details of the private life of a person regarded as a public figure A popular magazine published an article describing the life of a man, who in his childhood and youth, was widely heralded as an infant prodigy The article described his early brilliance and accomplishments and the widespread attention and publicity which he received. It then described

his general breakdown and the revulsion which he afterward felt for his former life of fame and study. The article pointed out that he attempted to conceal his identity and to escape publicity by choosing a career as an insignificant clerk.

Suit was filed by the unwilling subject of the article, contending that it constituted an unwarranted invasion of his privacy The Court, however, disagreed with this contention and dismissed the complaint, holding that the article was not an illegal invasion In reaching of his right of privacy its conclusion the Court first pointed out that it was not contended that any portion of the article was untrue Court conceded that it was "merciless in its dissection of intimate details of its subject's personal life" On this point the Court ruled, however, that the facts with regard to even the private lives of persons regarded as public figures had legitimate news value, and as such, could be published by a periodical

The reasoning of the Court in reaching its conclusion is set forth in the following quotation from its opinion "Revelations may be so intimate and so unwarranted in view of the victim's position as to outrage the community's notions of decency But when focused upon public characters, truthful comments upon dress, speech, habits and the ordinary aspects of personality will usually not transgress this line Regrettably or not, the misfortunes and frailties of neighbors and 'public figures' are subjects of considerable interest and discussion to the rest of the population. And when such are the mores of the community, it would be unwise for a court to bar their expression in the newspapers, books, and magazines of the day

Rad Faith

T has recently been held by the New York Supreme Court that a manufacturer, who falsely and in bad faith notified the customers of a competitor that he was the owner of a trade mark and that it was duly registered in the United States Patent Office, was guilty of unfair competition

In the case in question the ownership of the trade mark was in dispute between two competing manufacturers The trade mark was not registered by either of the manufacturers in the United States Patent Office. In spite of this fact, one of the manu-facturers notified the customers of

-LEGAL HIGH-LIGHTS-

the other that he had registered the mark in the Patent Office and that it was protected by the federal trademark laws.

The injured manufacturer brought suit charging unfair competition and the Court austained the auit holding that the false notices, sent in bad faith, constituted unfair competition While the injured party sustained a moral victory, and no doubt a certain amount of consolation from the victory, he did not receive any tangible recompense for his injuries. The Court held that the damages were of notice accretiance and awarded only nominal damages in the amount of one dollar.

Inescapable

In a decision which is unusual only in that the conclusion reached is so obvious that a layman might wonder why it was necessary to obtain a judicial determination, it was held that a talking moving-picture is a moving picture. The owner of a copyright on a play granted the exclusive motion-picture rights in the play to a moving-picture producer who subsequently produced a talking moving-picture based on the play It was contended by the copyright owner that the talking moving-picture in from seed in its copyright since the line lower.

The copyright owner argued that according to a custom in the industry the granting of motion-picture rights in a play did not in and of itself give the right to use the dislogue. The Court rejected this argument, however, and the court rejected this argument, however had granted the exclusive movement and granted the exclusive motion-picture rights to the producer and that a talking motion-picture sundoubtedly a motion picture.

In this connection the Court stated "The plaintiff cannot escape the obvious conclusion that a talking motion-picture is a motion picture."

Paint Remover

A FROCESS for removing paint by means of infra-red rays was held to be patentable by the Court of Customs and Patent Appeals. The process consisted of generating a beam of infra-red radiation substantially parallel to the internal line focus of controlly parallel to the internal line focus of the court of the court

The Court reversed the Patent Office and held that the process as described above was patentable because it was not only new, but also produced useful and improved results over the old method which did not employ a reflector.

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Succasaru. Prin-Gaan Negative Processine, third printing, is an informative little handbook presenting a complete explanation of the process of fine-grain developing, stripped of technicalities. Included are detailed instructions for the actual development of an exposed of the processing of the proc

TRANSPORTATION PROGRESS, by Arthur Pound, is a 52-page reprint from 'The Turning Wheel.' It traces the history of self-propelled vehicles from earliest times down to the modern motor car. included are a number of interesting drawings of ancient vehicles. An appendix lists milevelies and appendix lists milevelies and appendix lists milevelies. An appendix lists milevelies are not to be appendix lists milevelies. An appendix lists milevelies are not appendix lists milevelies and appendix lists milevelies. An appendix lists milevelies are not appendix lists milevelies. An appendix lists milevelies are not appendix lists milevelies and appendix lists milevelies.

SCRIM MACHINE EMONIFERMING is a new monthly periodical which should be of interest to all whose work touches in any way upon machine production that involves the use of turret lathes, chucking machines, and other equipment in the screw machine field. Screw Machine Engineering, 34 West Main Street, Rochester, New York—Subscription rate on applica-

TREMOCOUPLES IS a 40-page catalog of assemblies, parts, and accessories which includes information of general usefulness on the correct colors of the color of couples. Tabulated in easy-to-use form, this information will exerve as a guide to the selection of couples for specific applications. Completely illustrated. Leads cad Northrup Company, 4234 Steaton Avenue, Philadelphia, Pa.—Cropps.



SCIENTIFIC AMERICAN

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ANTI-AIRCHAFT COORDINATION with the air forces of the United States (see page 311) is essential to an adequate serial defense program. This mouth's cover illustration shows, foreground, an aircraft range-finder that work in close co-operation with the anti-aircraft guns, background. Photograph by Robert Yarnall Richte, taken at Camp Buchanan, Puerto Rico

CONTRIBUTING EDTOMS

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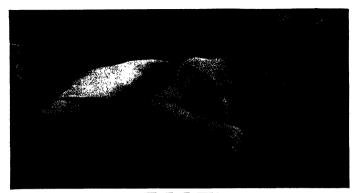
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HER HEALTH IS IN YOUR HANDS

 $B^{\text{efore this}}$ child reaches maturity, Tuberculosis may be eradicated from the United States.

But remember, she is growing up in a world where Tuberculosis still causes more fatalities between the ages of 15 and 19 than any other disease!

By buying and using Christmas Seals you will enable your Local Tuberculosis Association to continue a year-round fight that has helped to reduce the death rate from Tuberculosis by 75% during the last 33 years!

So protect this child—and every child in your community.



PLASMA TO BRITAIN

THE wealth and ingenuity of America face no insurmountable difficulty in rendering enormous aid to the valiant British Well and good! We all do what we can, and our cheers go up as we note with what apirit our kinsmen across the sea make use of the weapons of defense we send them.

Some emotion deep within us stirs, however, when we read of a particular gift made, at this writing by some 6000 New Yorkers, to the British cause. The weapons we've shipped, defensive though they are, have to do with death while these 6000 donors have given life—something of both body and spirit—for they have given ther blood. Three thousand quarts of their blood have been processed, put into blood banks for transfusions, and probably much of it has been shipped to England by this time.

It is appropriate to recall here the fact that blood banks were conceived by an American surgeon, Dr. O H Robertson, in France during the World War. A little added sodium citrate prevented healthy blood-drawn from the veins of others-from clotting, and it could be kept in bottles in refrigerators Two to four weeks was its keeping limit, however, and, in transfusions, the patient had to be given a type to match his own The former limitation would give us insufficient time both to collect and then ship refrigerated blood overseas, and the second added the danger that the seriously wounded person might die while his blood was being typed Happily, these limitations no longer exist. A research group of the Rockefeller Institute for Medical Research has developed a way to extract from blood both the red and white cells, leaving only the plasma And the plasma which we are now sending to the fighting British will keep for years, and may be transfused into any patient regardless of which of the four blood types he has

when he has a megalomaniacs may pervert to inhuman use some of the products of scenee, but here is one that cannot be so perverted. It is a life-giver, not a death-dealer. The process itself marks a milestone in the advancement of man's knowledge. But when so many persons utilize it voluntarily—under no compulsion of patriotism or self-preservation—to render precious aid to a friend, then does our fath in humanity receive a heartening boost.—F. D. M.

WHOSE FAULT IS IT?

no one today even thinks of asking whether concrete will prove to be permanently acceptable as a material of construction Of course it will It will, despite certain observable faults

For the past weeks the writer has been taking note of each piece of concrete construction, large and small, seen in the course of ordinary lafe—factory buildings, bridges, railway platforms, sidewalkk, posts—not in any special capacity but as anyone having an ordinary interest might observe. It turns out that the job which has stood up even for a few seasons without extensive creake, chunks spalled off, unsightly patchings and other evidences of deterioration, is rather exceptional. What or who is to blame?

Essiest, of course, is to blame the constructor. Maybe he cheated. Probably he lacked pride of workman-



ship Perhaps he was ignorant of best methods, though ignorance about concrete is less common today among its users than it once was, thanks to years of instructional hammering by the Portland Cement Association and others.

Economics and machinery have exerted an interesting kind of control over concrete for the past half century, divisible into three periods: First, in the last century most of the cement used was imported from Europe and was expensive, but labor was cheap. It paid, therefore, to mix the concrete stiff, with just enough water to wet it barely, which in turn required laboriously ramming the non-flowing mix into place by hand. Such concrete has maximum strength. Some of these old tobs are still giving fine service:

The second period came with relatively cheap American-made cement but expensive labor Stiff mix and hand ramming then passed out and most work was pouted—too much of it at the water-weakened consistency of soup Much of that work deteriorated

Today we are in the third period. Cement still inexpensive, labor quite high but better methods available for placing less soupy, hence stronger, concrete, also, wibrating machinery is available for ramming it inexpensively. Much better work is being done but, even so, much of it soon looks mangy.

It is believed that if the ultimate people, largely the public, who pay for concrete work and not merely the engineer, clearly understood only a few basic facts about it, higher standards of workmanship would result, since these can be attained wherever they are appreciated, demanded, and willingly paid for The cleanness of the materials is not, as is so commonly believed, the most important factor in obtaining sound. strong concrete, though it still is very important There are two other big factors One is the amount of water used-the more water the less ultimate strength, in a ratio as great as three to one between stiff and soupy mixing This of course takes more time and costs more money. The other is curing, something too often dispensed with altogether. After the concrete has set enough to prevent it from washing away, the surface is kept wet for some days, preventing the escape of the correctly proportioned amount of water needed within to combine chemically and permanently with the cement.

Concrete is a coarse material but it pays to be fussy with it

These points may seem elementary to engineers, yet, when it is realized that there still are many persons in other lines of work who think the setting of concrete consists of drying it out, they may not be altogether out of place—A. G I

50 Years Ago in . . .



(Condensed From Issues of December, 1890)

DEFENSE.—"It has for many years been patent to every one that New York City, with the great industrial forces and vast aggregate of wealth concentrated around what is known as the Port of New York, are entirely without defense against such an attack as might be made by the vessels of any first class power with but a few hours'



notice A plan quite unlike anything heretofore attempted anywhere for the construction of forts for the defense of the ocean approach to the city ward by Mr John F. Anderson, a New York engineer, and consists in the construction, on artificial Islands, of three forts, each with a diameter of 500 feet, between Rockway Beach, on the Long Island shore, and Sandy Hook point. They would be about two miles apart, and the same distance from each shore, so as to command. a like cleaning the control of th

PIGEONS—"Efforts are now being made to introduce a carrier piegon service into the United States Navy War vessels employed in defending a coast are often without the means of transmitting information of the utmost importance to the mainland. By means of carrier piegons they could send communications ashore over a distance of several hundred miles, signal the approach of the enemy's feet, and report all his movements."

FIRELESS LOCOMOTIVE—"A fireless locomotive for use in mines is provided with a tank that holds 0.550 cubic meter. The water is heated to 205° C. (or an absolute tension of 18 atmospheres) by a boiler placed on the surface, it is sufficient for a steady run of 3 to 4 kilometers".

ROPE—"Ropes sometimes wear out internally while apparently sound outside. This is caused by bending the rope over a sheave. In doing this the fibers slide a small distance upon each other and eventually wear out. In the best ropes this wearing out is prevented by lubricating the strand with plumbago, mixed with a small quantity of tallow, just sufficient to hold it in place."

LOG RAILS—"Mr Angus McPherson of Cumberland County, Nova Scota, has built 1½ miles of railway into his tumber woods this summer and is now running a train on it. The rails he used are round spruce poles, six inches in diameter at the larger end, tapering down to half the size, and neatly joined at the ends. The sleepers are small exize, and neatly joined at the rails are spiked. The rolling stock consists of a small puright engine, eight horse power, and two flat car wall upright engine, eight horse power,

METER.—"A new penny-in-the-slot contrivance has been adopted by the gas department of the corporation of Birmingham, for the benefit of small consumers. A sort of meter has been constructed, which, on dropping a penny in a slot, will deliver twenty-five cubic feet of gas."

BRIDGE—"The great steel bridge across the Columbia River, at Vancouver will be 5,000 feet from the Washington to the Oregon shore. It will be double tracked, with a roadway on top for teams, and will be erected upon pneumatic piers. The prvoted pier, or draw pier, will support a draw which will give an opening of 200 feet space on either side for vessels to pass, and the span immediately south of the draw snan will be 375 feet."

PATENT CENTENNIAL—"The wealth and economic prosperity of our country are so largely due to the system of patents, by which our inventors have been encouraged to pursue their unselfish labors, that among the many centennials which have been and are to be commenorated, the one hundredth anniversary of our patent system should not be overlooked."

BIG GUNS.—'The chief of the bureau of ordnance, Gen SV Benet, in his . annual report, notes that a twelve-inch breech-loading steel rifle is now nearing completion at the Waterviet Arsenal, and will probably be ready for trial in February This is the largest size of modern gun we have yet attempted to manufacture, but the Watervilet plant is being put in shape by the government to turn out, also, sixteen-inch steel guns. These guns will be fifty feet long and weigh 125 tons each, requiring a full firing charge of 1,000 bounds of powder. and did if the state of the course of the first powder is and the guns will have a maximum range of about fittee miles.'

CHIMES—"Dr Alva Owens, of Chicago, recently constructed a set of chimes to be rung by electricity. Attached to each of the thirty bells hung on the rack above the key-board is an electro-magnet. The keys make the circuit from a battery in the base to the electro-magnets at the bells"

STEEL—"The Otis Steel Company, of Cleveland, which has the largest plate mill in the world, a few days ago rolled a 20 inch ingot of 8,500 pounds down to three-quarter inch plate with one heat."

BUILDING—"The new Masonic building now being erected in Chicago will be an architectural marvel. It is to have a frontage of 170 feet, a depth of 114 feet, and will be twenty stories high, and the root will be nearly 300 feet from the level of the street. There are to be eighteen elevators, arranged in a semi-circle, having a total carrying capacity of 40,000 passengers daily."

SMOKELESS—"The hasis of all the new kinds of smokeless gun-powder is cotton subjected to the action of nitric acid and the consequent formation of mone, bi-, and tri-nitrocellulose according to the strength of acid employed. This new powder is said to be on the average three times as powerful as the old."

Personalities in Industry

owe before the poet wrote of trees, Martin L. Davy knew that they were creations to chernal-living the control of the control

Martin L Davey was born July 25, 1884 in a small, rude home built with his father's own hands in Kent, Ohio Young Martin started on his business career when he was six years old by pedding vegetables gathered from his father's truck garden. All through elementary school, he added to the family income and later financed his way

through high school.

Martin had an exceptional father. John Davey, who has been called the "Father of Tree Surgery" book, "The Tree Doctor," published in 1901, laid the foundation for the science of shade-tree care and awakened people to the fact that tree life could be preserved, nurtured, and maintained in healthy condition for the enjoyment of everyone John Davey, the father, was something of a dreamer and idealist, and needed just the executive and administrative ability early displayed by his son, Martin During Easter vacation in 1906. young Martin decided to join forces with his father, and left Oberlin College. At 22, he organized his father's affairs into an incorporated company and became general manager He now is president of the Davey Tree Expert Company

Though not a scientist, Mr Davey has surrounded himself with a group of outstanding technical men. There has been constant improvement in technique, materials, of large trees has been one conspicuous development. Fifteen years ago, big trees were being moved on contraptions that resembled Spenish-American War artillery wagons. The Davey staff redesigned the equipment, using



MARTIN L. DAVEY

all modern aids to make it highly efficient special metals added strength and reduced weights, a change was made from iron to pneumatic tires which cut into the ground less and have advantages of speed, the general mechan-18m was improved so that trees could be more readily and safely handled A practical injection method for the successful treatment of chlorotic trees was developed, and, currently, injection experiments are being conducted with a view toward controlling serious tree diseases

The battles Martin L Davey has fought in behalf of shade-tree preservation have been waged not only for his own company, but no directly for all other organizations in the same field, for his theme has always been "Better and healther trees kept in good condition by qualified experts" To give the best service to the public, Martin L Davey started the Davey Institute of Tree Service in 1909 In its first vear the school had a

few students meeting in a hall over a store but developed into a threewinter course with a peak attendance of 447 employees Most of the company's thousand field men and its 70 sales representatives are graduates of the school

The company had little capital in its early days, no one cared to invest in such a "fool" enterprise as taking care of trees. There were scoffers aplenty but Martin L. Davey's fath in his father's ideas and in his own ability to translate them into actual practice for the benefit of tree life, admitted on failure.

Politically, too, Martin L. Davey has had a successful career At the age of 29 he was elected mayor of Kent, was twice re-elected, and at 34, while serving his third term, was appointed to fill the unexpired term of the Congressman for the 14th District of Oho who had died in office Twice nominated for Governor of Ohio, Martin L. Davey was elected on the second occasion in 1934 and was re-elected in 1936.



EIGHT STREAMS OF METAL STINGS

Any times the British Spitfire has proved itself the deadliest frame, in general use during the present war. In this drawing, showing the plane cut away so that its equipment is visible, a Heinkel bomber is being slashed to pieces by a withering stream of bullets from the Spitfire's eight Browning (American) machine guns Empty cartridges and links of the cartridge belts (which disintegrate on firing) stream behind from 180 shots per second. All eight guns are fired together by simple pressure of the pliot's thumb on a button on the "stick." Smaller, lighter, and slightly less maneuverable than the Hurricane, the Spitfire has a speed of 985 miles per hour Some Spitfires have been mounted with shell guns, and all now have partial armor protection for pilots and tanks, such protection having been found on no crashed German planes. Super versions of both Spitfires and Hurricanes have recently been produced.

AIRPOWER FOR DEFENSE

Strategic Regairements of Aircraft in All Services

IAMES L. H. PECK

THE United States has been forced by world conditions to assume the defense of what is, to all strategic intents and purposes, half of the world. This involves the maintenance of strategic security of North and South America and, roughly speaking, the western half of the Pacific—a tremendous task which even a two-ocean Navy and a 1.200,000-man Army could not accomplish without the aid of that greatest of modern weapons—auroower.

Our airpower is not made manifest by an independent air force. but by the Army Air Corps and the Naval Air Service, each of which employs particular types of planes that are best suited to naval and army operations The Navy is immediately concerned with the control of the above-mentioned sea areas, it is our "first line of defense" Without such control. American commerce could be blockaded from points far removed from the coasts and beyond the range of shorebased aircraft Our insular possessions, or those of friendly powers, could be occupied and used as enemy advance bases against us, and this could be followed up by the establishment of hemisphere bases from which the United States could be attacked by airpower assault and sea power "investment" Fortunately, the Navy in general and its air arm in particular are in a position to exercise control, in that they have immediate access to information concerning enemy activity in these sea areas and also the power to reduce such activity. Thus, the strategic requirements for our Naval Air Service craft are the ability to gain enemy information and the flexibility and striking power to counteract hostile operations

The first assignment is delegated to the "big boats" — the huge, multi-motored flying boats known as patrol bombers—and the scouting squadrons of the Fleet's air-craft carriers The Consolidated PB2Y-2 boats, 18 of which will shortly go into service to form a new patrol squadron, are our best type Powered by four radial air-



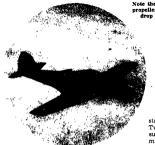
cooled motors, they have a range of more than 5000 miles carrying a nine-man crew and several tons of bombs Their famous predecessor type, the Consolidated PBY boat, is the present first-line patrol bomber and has a range exceeding 3000 miles. Operating from the recently acquired Atlantic bases and those in Alaska and the Pacific. these long-range craft can effectively patrol our "half" of each ocean On mission, the squadron planes fly in a fanned-out scouting line miles out of sight of each other but in a precise line maintained by radio contact and exact navigation Even so small a number of craft can, in this manner, cover a remarkable amount of territory; they are in truth the "eyes of the fleet."

Not so far-sighted are those "eyes" represented by the carrier-based scouting squadrons, whose main purpose is to spy out advance units of the enemy fleet—submarines and cruisers or aircraft The carrier's main function, however, is the fulfillment of the second Navy requirement—striking power, or the delivery of firepower—and to this end our floating air—and to this end our floating air—

ports accommodate Douglas TBD-1 torpedo bombers and Northrop BT-2 dive bombers (Both scout bombers and patrol bombers live up to the second part of their designations once they spot the enemy, the big boats bombing from level keel at high altitudes while the scouts get right down to things by dive-bombing tactics) The carrier fighter complement boasts such sterling combat planes as the Grumman F4F3 and the Brewster F2A-2 at present, a quantity of the sensational 450-mile per hour Grumman Skyrockets are on order

The seaplanes carried aboard the Fleet's battleships and cruisers are employed for short-range scouting and range - correction. they are sent aloft from catapults. then land alongside to be hoisted aboard by cranes Training planes of various types, and utility craft for the transport of personnel and matériel, are, of course, most essential Marine Corps Aviation is an integral part of the Naval Air Service and operates therewith as well as in support of Marine ground units. It is of daily growing im-portance because of the apparent necessity of garrisoning both the new Atlantic bases and establishments in Central and South Americo

MTHIN 100 miles of our coasts, the Army Air Corps takes over, and theirs is the big job of continental air defense, together with that of the Panama Canal Zone Because of our long coastlines and the necessity for close co-operation with our neighbors to the north and south, it is vital that we have a powerful, highly mobile striking force that may, in whole or part, be shifted from one section of the country to another within a few hours Such is the General Head-hours Such is the General Hea



Note the 37mm cannon in the propeller hub, and the teardrop cockpit of this Bell P-39 Airacobra

quarters Air Force, which may best be described as an air force within an air force, since it consists of all the combat squadrons within U.S. borders The GHQ Air Force may operate in close support of ground forces in the United States, Canada, or Mexico, in joint Army-Navy operations, or completely independent of land or sea units. Supplementing this roving "big stick." are several Air Corps tactical units in strategic points of the country, in the Canal Zone and the Hawanan Islands, new establishments are under construction in Alaska and Puerto Rico

BOMBARDMENT is the mission of airpower, the fist of the air arm, even as infantry is the fist of the Army. The Air Corps egglayers are divided into three groups: Heavy Bombardment. Medium Bombardment, and Attack Bombardment The former include the "flying fortresses"-so-called because of the amount and disposition of their defensive armament -that are capable of carrying huge loads of bombs for great distances Outstanding of these are the fourengined Consolidated B-24's which have a range of some 3000 miles with a nine-ton bomb load. On shorter missions, with less war load, they have a top speed in excess of 370 miles per hour, and climb to the pursuit-ship altitude of 36,000 feet Planes of the Medium Bombardment group are smaller faster and operate over shorter distances The twin-engined Douglas B-23 and the 400-mile per hour North American B-25 are the newest types. Attack bombers engage in short missions involving strafing and dive-bombing of troops and stationary objectives. Twin-engined types such as the almost-400mile Douglas A-20A carry fairly large

quantities of bombs and armament: single-motored craft such as the Vultee YA-19 and Republic Guardsman do the dive bombing Reconnaissance aviation charged with the maintenance of

strategic security over land, just as the scouting force guards against surprise at sea. Due to developments in Europe, the Air Corps has discontinued use of the observation plane of medium range, as is evidenced by the lack of orders for the robin-breasted North American 0-47 series, the finest line of planes of this type ever built by any country. For distant reconnaissance, it seems safer to send the heavier - armed bomber, most of which have provisions for installation of aerial cameras anyhow Liaison missions-the purpose of which is to maintain contact with ground units, keep the divisional command informed as to his advance force's location, progress, and requirements, and "warn" these units of enemy movements which might jeopardize them-and artillery "spotting" are best carried out by relatively slow craft or sutogiros that can land on a roadway or nearby cow pasture during operations in the field. Latest and best of these "puddle jumpers" are the Ryan YO-51, the Stinson O-49, and Curtiss O-48, all high-wing monoplanes pow-

Pursuit is the Air Corps' fighting force, and our combat planes are known as pursuitinterceptors and convoy fighters The former types would go up to engage enemy bomb-

ered by radial engines

ers or observation craft in defense of a city or area and the convoy fighters would accompany bombers or reconnaissance planes on a mission in order to protect them against enemy pursuit. By the time this is in print, the Air Corps will have taken delivery on quantities of Curtiss P-40's, Bell P-39 Arracobras. Bell SM-1 Airacudas, and Lockheed P-38's. The first two are single-engined ships, while the SM-1 and P-38 are powered by twin Allison motors.

These Navy and Army aircraft are by far the finest in the world but there are all too few of them. There are not enough pilots and ground personnel to fly and maintain the 25,000 Army and 10,000 Navy planes we hope to have by the end of the next fiscal year; nor are there adequate bases and airdromes on which to put them. Thus, the United States is concerned at the moment with the procurement of planes, engines, accessories and spares, and armament; pilots and combat crews-gunner-observers, hombardiers, navigators, and radiomen, mechanics, radio technicians, sheet metal workers and welders, armorers, parachute riggers, meteorologists, flight surgeons, and technicians and specialists of a dozen other callings-all of which are a pre-requisite of airpower The



Planes and anti-aircraft must be seed

airport program is at last under way.

way. We have mentioned the different types of craft used by both services to conform with the defense requirements of the Army and Navy Fighters fight, and bombers bomb; but our warplanes are of diverse design and construction because of the difference in specifications and operating conditions. There are reasons, remediable and otherwise, why the services cannot seem to agree on a few basic designs Standardization would, of course, greatly expedite production, and to this end the Aeronautical Boarda liaison agency headed by the chiefs of the Air Corps and Naval Air Service-is seeking to coordinate production methods, machine practice, aero research, and exchange of technical information The principal difficulty arises from the "extras" which Navy planes must incorporate-"flotation gear". specially treated, corrosion-resisting alloys, special radio equipment. nautical instruments and signalling devices, and personal essentials such as life jackets and emergency rations

Carrier-borne aircraft are stressed to withstand the rigors of deck landings and arresting gear and the recoil shock of gunffer These are "musts" An Army plane



ed. This gum fires 25 shells per minute



Powered by a 1200-horsepower Allison liquid-cooled engine, "several per day" of these Sterling-Curtiss P-40's are rolling off the production line

not so stressed, and unprotected against the deteriorating effect of salt water and spray would fall apart after a few months' carrier operations Nots on aparent are the reasons for different kinds of bolts and nuts on an otherwise identical pair of Wright Cyclone motors (differing hardware specifications), two inspection and testing routines, and separate sets of reamers, dies, collets, and so on for tooling. As if the machine-tooling bottleneck were not tight enough on general principles!

SOMEWHAT less of a problem, but requiring more time per unit, is the training of air personnel A swift fighter may be built in seven days; an embryo pilot must have that many months of training before he can safely fly this tricky, hot-tohandle ship. The Air Corps is well started on an ambitious program involving the training of 7000 pilots and 3000 bombardiers and navigators annually. Primary instruction will be continued at the nine Armysupervised commercial flying schools, some of which are opening branch schools to accommodate increasing quotas. Then aviation cadets will be sent to one of the three training centers for basic training, advanced and specialization work. Randolph Field, San Antonio, Texas, long known as the "West Point of the Air," is now called the Gulf Training Center. Maxwell Field, Montgomery, Alabama, formerly the home of the Air Corps Tactical School, is known as the Southeast Training Center; and the West Coast Center is located at Moffett Field, California Cadets spend 10 weeks in the civilian school and 25 weeks at the training. center, after which time they are sent to tactical units for active duty

Navigators undergo three weeks of "ellmination training" at one of the Naval Reserve Aviation Basea before they are sent to the Naval Arr Station at Pensacola, Florida, to complete their aerial education. Because the Navy plans to train 10,000 pilots within the next two years, three air stations are under construction at Jacksonville and Copa-Locka, Florida, and Corpus Christi, Texas. Enlisted personnel and technicians receive their schooling at the Naval Establishment at Pensacola

Air Corps mechanics, armorers, parachute riggers, instrument specjalists, radio operators, and other enhisted men learn about maintenance of an air force at the Technicial Schools at Chanute Field, Rantoul, Illinois, and Lowry Field, Denver, Colorado. Others are enrolled in seven Army-supervised civilian schools. These are the warbird's housekeepers The Army's 3000 bombardiers and navigators will be tutored at the Pan American Airways school at Miami

Neither Pan American nor the other airlines will step out of character further, because these carriers must bear the brunt of our steppedup commerce if and when M-Day comes Nearly as busy as the airlines are the service planes of the Utility branch. Cargo planes, transports for officers and enlisted personnel, and ambulance craft ply back and forth between bases and aircraft carriers on their errands of military mission and mercy. Newest of the transports is the Douglas C-47, of which a quantity have been ordered for the new parachute unit undergoing training in New Jersey.



Pratt & Whitney's 1859-horsepower engine. Extended nose facilitates streamlining

This 1940 has indeed been a momentous year, but within the coming year we shall witness even a more rapid march of aerial progress Aeronautical research, genesis of airpower, in our NACA laboratories. Naval Aircraft Factory, Wright Field, and that of the aircraft and engine manufacturers. is being extended in the quest of new aerial findings and methods for exploiting them Most exhaustive of research is the actual war-testing of our various American prototypes, and we have already profited by experience We have two types of leak-proof fuel tanks which are far superior to anything known to be in service abroad, we have the finest aerial armor plates, automatic shell cannon and heavy caliber machine guns in the world, we have the only fool-proof bombing sight America's warplanes, on which these accessories and armaments are being installed, out-perform by far any European War II craft of any type or model, and they are built to higher specifications standards and of materials that are vastly superior

Anti-aircraft defenses. with which interceptor forces should be coordinated, are likewise improved. particularly the fire-control devices Newest of these is the detector which utilizes the infra-red radiation given off by airplane engines, and concentrates this diffusion of rays into a visible image on a ground screen The range-finder and Sperry-Wilson "predictor" automatically ascertain the altitude. speed, and course of the imageenemy plane-and the guns are fired accordingly. Experiments are being conducted with an infra-red ray searchlight, which may later be used in conjunction with this telescope detector. To assist further in aerial defense, the Aircraft Warning Service has been inaugurated to enlist civilian aid in the spotting of enemy planes

It is highly probable that performance of our craft will be increased more than 10 percent during the coming year Aerodynamical advances such as the remarkable Davis aerofoil — used to such advantage on the Consolidated B-24 heavy bomber— and eignneering innovations should make this possible The Lockheed

P-38 is reported to have attained the long-sought 500-mile per hour mark at this writing, and the limit does not appear to be in sight

It is not all sunshine, however Productive industry is slow getting into high gear, perhaps through no perticular fault of its own. The machine-tooling bottleneck is still seriously narrow, as is also the air-caft instrument situation. Skilled tradesmen are not plentiful. There is a surprising and unreasonable lack of Army-Navy air coordination, despite the efforts being made in certain quarters to alleviate this condition. There is far too much politics in defense in general and aviation in particular.

But we have surmounted higher obstacles We inherit certain imponderable qualities with which America alone seems blessed these dark days Spirit and morale which is inspired by the heart and feeling of a free people-not the sort born of extreme nationalism and propaganda ministries-and the mechanical heritage of the American youth supply him with the finest flying background obtainable our excellent services furnish him with the finest training obtainable, our industry and engineering genius afford him the finest of equipment This is the American Way On land, sea, or in the air, it will be hard to beat

RUBBER DIE

Pad Used With Single Forming Die

By using a flat, thick pad of rubber in the fabrication of airplane parts, the Douglas Aircraft Co., Inc., has been able to lower die cost and speed production in line with our needs for national defense. When operating with this rubber pad, only one die is used and tooling methods are simple. The labs of rubber are the largest pieces ever designed for commercial application by the Goodyear Tire and Rubber Company, weighing approximately 4000 pounds and measuring 180 by 57 by 11 inches. This development was reported in a recent sissue of India Rubber World

In application, the rubber is confined within a steel container which descends on a lower press table where many types of dies may be operated simultaneously. When the sheet metal is laid upon the rubber slab and pressure is applied, the rubber conforms to the shape of the dies, thus forming and blanking metal sheets into their desired shape.

The Guerin process, as it is known, makes possible an exceptionally high strength-weight ratio by forming sheet metal quickly into a rigid structural part, eliminating the need of stiffening members

DIVE-BOMBER

THE United States Navy is testing out a new all-metal Curtiss-Wright dive-bomber, the XSB2C-1. Greater range, increased machine-gun fire, higher speed, heavier bombs, are all claimed for this machine, although beyond a statement that a 1700



Just after bomb release

horsepower double-row Cyclone is to be employed, no details are given. The artist's drawing hints at flaps to retard the dive, wheat completely retracted and drawn up and sideways into the wing, and bomb bays with bombs carried horizontally under the belly of the fuselage.—A. K. NAZIS POOR "GAS"—Gasoline used to power German airplanes in general is from 70 to 80 octane rating, equivalent to our standard grades of motor fuel, whereas the RAF has aviation grades of gasoline, thus in part accounting for the apparent superiority of the British fighters—Oil Weekly

UNBREAKABLE SPECS—Eye-glasses are worn by one football player, Thatcher Longstreth of Princeton These are of the contact lens type—Visual Digest

TUNNEL MILEAGE—There are 1539 railroad tunnels in this country with an aggregate length of 320 miles—Notes, Association of American Railroads

WE USE MORE SNUFF—The average person, thinking of soulf-taking as a rather ancient habit, will be surprised to learn that from a little less than 4,000,000 pounds in 1880, production jumped to 41,000,000 pounds in 1929 Nowadays, however, snuff is used generally like chewing to-bacco—U S Department of Agriculture

QUIETER CARS—About 400 pounds of rubber, in 1009 rubber parts, are used in the modern streamlined trolley car which is built to the specifications of the President's Conference Committee of the street railway industry—India Rubber World. Settember 1, 1940

GELATIN ENERGY—There is no evidence that gelatin cocktails are harmful in themselves, but it is yet to be scientifically proved that they do us any good—Dr Iago Galdston, in Hygera, October, 1940

LIGHTNING STRIKES TWICE—Lightning struck the Empire State Building at least 20 times during the period between April and October, 1940 Because the building is properly grounded no damage resulted—Notes, General Fleetric Company

SMALLER THAN BACTERIA—It would take something more than 5,300,000,000,000,000 smallpox viruses to weigh one ounce—Dr Thomas M Rivers, Rockefeller Institute for Medical Research

ACRES OF RAILROADS—Approximately 4,000,000 acres of land, equal to about one sixth of the area of Indiana, are used by the American railroads for rights-of-way, yards, shops, station grounds, and other transportation purposes—Notes, Association of American Railroads

NITRATES—Preliminary results of an experiment at Woolnoghar Experiment Farm have shown that, follow-woolnoghar Experiment Farm have shown that, follow-ing a short fallow, the nitrate nitrogen content of the soil is considerably increased. Half of the experimental plots were fallowed for about two months, the other half remaining under pasture Analysis at the end of the above period showed that the plots under pasture contained an average of 4.5 parts per million of intrate introgen while the fallowed plots averaged 60 parts per million.—The Adricultural Gazette of New South Wales

HIGHEST TEMPERATURE—The highest man-made temperature on record—18,000 degrees, Fahrenheit—has been produced by Dr. C. Guy Suits This is twice the temperature of the Sun's surface.—Notes, General Electric Company.

PHYSICALLY UNFIT—Approximately one third of the nexamined for World War service, reports Dr. W S Leathers of Vanderbilt University School of Medicine, were physically unfit for military duty—Science Service, October 8, 1940.



HELIUM—More than 100,000,000 cubic feet of helium have been produced at the U S government's plant, only one in the world, in 11 years of operation. That quantity is sufficient to inflate nearly 20 monster airships, such as the ill-fated Macon and Akron—Science Service.

FAST WINGS—Hummingbirds' wings beat 75 times a second in flying and 55 times a second when the bird is hovering The bird's flight reaches a speed of nearly 50 miles an hour—Dr Winsor M Tyler, Smithsonian Institute.

RESEARCH PAYS—A survey made by Dr. Karl Compton, Chairman of the Advisory Committee on Scientific Research of the National Association of Manufacturers, showed that out of 188 companies covered in the survey, 10 companies spend more than 10 percent of their gross income on research, while the average spent similar to the companies of the survey of the companies of the companies of the survey of the companies of

1000 WELLS PER MONTH—More than 1000 wells are drilled each month in the United States in seeking oil These are from a few hundred feet to more than two miles deep and run in cost up to \$250,000—Oil and Gas Journal

TONS OF DUST—Dust storms carry tremendous amounts of material. It has been calculated that during some of these storms 126,000 tons of dust per cubic mile of air is lifted and carried by the wind—Blackwelder and Barrows "Elements Of Geology".

RAYON TIRES—Rayon cord tires have given as much as 30 times the mleage of ordinary cotton cord tires in speak as the standary cotton cord tires in speak speed run in a bot country, rayon tires lasted 80,000 mills while ordinary tires wore out in 3000—William H Bradshaw. E. I Du Pont de Nemours & Company, Inc.

INCUBATION—Both the Egyptians and the Chinese knew how to hatch chicks artificially more than two thousand years ago, using crude equipment and laborious methods —Chip Sheet No 1158, U S Department of Agriculture

SILVER STERILIZES—Silver as a sterilizing agent for drinking water may be used in the ratio of one part of silver in 10 to 20 million parts of water to render the water safe for human consumption. The cost would be but \$20 \$4 per million gallons of water—Dr Alexander Goetz, California Institute of Technology.

FOREST RED—Green fields and forests emit a ghostly red light. Though this is invusible to human eyes except with special instruments, it is of fundamental significance in the study of the basic physical process of life on earth— Drs. E. D. McAlister and Jack Myers, Smithsonian Institution

Government-Made Addicts

The Federal Alcohol Administration Still Follows on Ancient Tradition — Blindly

YANDELL HENDERSON, Ph.D.

Professor of Applied Physiology at Yale University

N the United States now the number of alcoholic addicts-the men each of whom consumes a quart bottle of whiskey, or more, every day-is quite constant, and quite constant, also, so far as can be estimated, is the number in each of our 48 states. In each the number of new addicts produced each year balances closely the number that die. In nearly every one of the 48 the system of liquor control differs in some details from that of every other state Yet these 48 supposedly differing experiments produce no appreciable differences in results Evidently, then, there is some fundamental factor that is the same in all these experiments, and that dominates the results in all some factor that prevails throughout the entire nation, and reduces all the 48 experiments to one That factor is the high "proof," or alcoholic content of our distilled spirits, chiefly whiskey, which is the same throughout the nation The Federal government alone controls that

Under Prohibition even the weakest liquors were forbidden Under the system to which we have reverted, and which is now maintained by the Federal government. distilled liquors of low or even moderate strength are virtually prohibited and only those of high alcoholic content are permitted to be labeled and sold as whiskey and other distilled liquors The underlving idea is that it is the duty of the United States government, through its supervision of interstate commerce, to guarantee the quality and quantity of all foods and drugs. It is held that the American citizen should receive full value for his money, whether he spends it for a can of tomatoes, a bottle of medicine, or a bottle of whiskey Accordingly, we have not only the Federal Food and Drugs Administration, but also the Federal Alcohol Administration; and under

the regulations which this Administration is authorized to make and enforce, no liquor of a strength below 80 proof-or 40 percent of alcohol by volume-can be labeled or sold in the United States as whiskey, gin, rum, or brandy In 48 states all kinds of experiments and efforts in endless variety are made to ameliorate what Lloyd George, its greatest ameliorator in England, called the "drink trouble:" and all are effectively counteracted by the Federal government, by its maintenance of this high proof requirement

How this condition came about is briefly as follows. In Colonial days our ancestors on the Atlantic Coast drank rum made from East Indian sugar or molasses But, when they moved west of the Allegheny Mountains, the difficulty and expense of transportation promoted the development of a local distilling industry that made use of grainchiefly Indian corn. When President Washington appointed Alexander Hamilton as the first Secretary of the Treasury, and Hamilton began to repair the almost bankrupt treasury, he looked about for sources of federal revenue He established a tariff on imports and by act of Congress laid a tax of 10 cents a gallon on whiskey Thereupon the Whiskey Rebellion broke out in western Pennsylvania; and President Washington used the armed forces of the Government for the first time under the Constitution to suppress it.

The excise men then collected a part of the tax, but the distillers evaded a part Alcohol costs little to make; but water is still cheaper, and two gallons of whiskey were easily diluted to three. There were few chemists to analyze the liquor and determine its concentration of alcohol. It was sufficient as a test of alcoholic content to moisten gun powder with the liquor, and try to

light it. If the content of alcohol was high enough, and the content of water low enough, to permit the powder to burn, that was "proof," or "100 proof." If the moist powder would not burn, the liquor was "below proof."

To meet this practice, the Government applied a measure that stopped the loss of revenue due to watering, and made 100-proof whiskey-that is 50 percent of alcohol by volume-the standard American liquor. It thereby did more than any other factor in American life to maintain for 150 years a steady production and reproduction of alcoholic addicts. The law specified the same tax "on each proof gallon or wine gallon below proof." The distiller could dilute his liquor, but if he did he must pay the same tax on the water that he added to the barrel that he did on the original contents of the bar-

Now the term "wine gallon" has nothing to do with wine. The first distillate from a primitive pot still was a liquor low in alcohol and was called "low wines" It was redistilled to produce a liquor higher in alcohol and called "high wines. Hence the expressions "wine gallon" and "proof gallon," which are both just a gallon in volume, but of different alcoholic content, and hence the practice of the Government of basing the federal excise on the "proof gallon" and taxing a "wine gallon" at the same rate, which has served effectively-and unfortunately-to hold American liquor up to high degrees of proof ever since. Even when it was allowed that, after the tax was paid. the liquor might be diluted to 80 proof-40 percent of alcohol-the idea persisted in the popular mind that whiskey, to be whiskey, must be of high proof-as it is to the present day.

History records several cases in which entire nations have within a few years developed a wide-spread addiction to extreme degrees of alcoholism. In all such cases the cause has been the introduction into popular consumption of high proof spirits with low taxes, or none. This occurred in England in the reign of Queen Anne. England was at war with France, and was allied with Holland So French wines were so far as possible excluded, and "Hollands," or gin, was favored as a sign of patriotism. Even when a low tax was imposed, it was largely evaded by smuggling. As a result, habitual drunkenness became appallingly general. The cause and condition were shown by a popular sign on an unn in a poor district: "Drunk for a penny; dead drunk for two pence; clean straw" (in which to sleep it off) "for nothing." And generations of higher taxation and strict control only gradually overcame the general intemperance of the English people: indeed, it lasted down to the War of 1914-1918.

If a low price and high alcoholic content tend to promote intemperance, there is equally strong evidence that high price and lower alcoholic content tend strongly to decrease intemperance. Lloyd-George, as Minister of Munitions, in 1915 found that heavy drinking by the workers interfered with the production of munitions. Accordingly, by act of Parliament, the distillers were allowed to dilute spirits much more than ever before; and the taxes were adjusted so as to make it profitable for them to do so As an outcome "The weekly average of con-

victions for drunkenness

in England and Wales, which in 1913 were 3482, had, by the first part of 1917, failten to 929." And the same general policy has been continued ever since, with the result, as Lloyd-George reports in his Memoirs and others confirm, "Britian today is a much more sober country than it has ever been in my memory." Government reports show that convictions for drunk-eness per 10,000 of the population in 1938 were only 23 percent of those in 1913.

In recent years the tax on liquor for consumption in England has been about \$13 per American proof gallon: contrasting with about \$3 a gallon for federal and state taxes together in this country. But this high British tax has been compensated to some extent for both producer and consumer by the allowance of a degree of dilution that makes "Scotch" in England a milderdrink than "Scotch" in America. where it must meet our taxes and required concentration. Under the British taxes and concentration the distillers make a satisfactory profit; the consumers are satisfied with their distinctly milder liquor; and the American visitor, finding that he can drink more than at home without serious effects, concludes that "it must be the climate." The benefit is further enhanced by the fact that "Scotch" is always further ethilded with "soda" by the drinkers; it is almost never drunk "straight," as is often the case with those in America—especially automobillists—who drink American



Courtey Caivert Distillers Corporation
Today, alcohol concentration in whiskies is proofed with
a hydremeter as it leaves the still, not with gun powder

whiskey direct from the bottle. Thus in Britain a high tax rate and a large legal degree of dilution have made it to the interest of the distilling trade to decrease the intoxicating quality of their product and thereby to decrease to a more than proportional extent the evils associated with it. In America, on the contrary, the system has always been one of low taxes, cheap liquor, and high alcoholic content: a system under which the distilling industry has found little incentive to develop a market for lower proof liquors. Yet it is quite certain that. until the federal government adjusts its taxes upward and the permissible degree of concentration downward, so that it will be to the financial advantage of the industry to offer and advertise lower proof liquors at prices that will contrast favorably per gram of alcohol with those of higher proof, the production of alcoholic addicts and other evils will not be lessened: no matter what the 48 states may do.

Even this is not the whole story of American maladjustment in liquor control. There is another important item the bootlegger One of the arguments adduced in support of low taxes on proof spirits is that higher taxes have always tended to promote the manufacture and sale of ilinet iliquor The government needs all the revenue it can get from the excise on spirits. It makes strenuous efforts to discover and suppress the moonshiner, the bootlegger, and the smuggler. Yet, at the same time, by its unwise

system, it has promoted the very conditions that it wishes to suppress It habitually penalizes the legal liquor industry in its competition with the bootleggers. It forbids the legal manufacturer and dealer to sell any liquor below 80 proof. while the illicit manufacturer and dealer can. and does, dilute his liquor to any extent that his market will tolerate. which is commonly between 60 and 70 proof: rarely higher. And the fact that illicit liquor is commonly diluted to 70 or below is decisive evidence that Americans are like Englishmen in that whiskey below 80 proof would be accep-table What 70 proof is

on the tongue is shown by comparing our 70 proof bootleg liquor with cocktails, for 35 percent of alcohol, or 70 proof, is the strength of a day Martini, and this, by the way, is about the highest concentration that can be taken habitually without destroying the mucosa of the stomach. No one can fairly complain that he gets "no kick" from a 70 proof drink.

Editor's Note: Professor Henderson's special competence to write on the subject dealt with above arises from the fact that he is an outstanding scientist and that one of his special fields of research long has been the physiological and social aspects of the liquor problem. Others are physiology of the circulation, bio-chemistry of respiration, and pharmacology of gases. He was one of the organizers of the Chemical Warfare Service, is the author of a book on industrial poisons, entitled "Noxious Gases." determined the standard of ventilation for the Holland Tunnels, and was the scientific authority on whose advice Congress legalized 3.2 beer as non-intoxicating under Prohibition.

For a fuller discussion of the

subject of the above article see a paper by the same author, in the new Quarterly Journal of Studies in Alcohol, Vol 1, Page 1, Yale University Press, 1940

RADIO KNIVES

War Casualties

May Benefit

MEDICAL science has made such great strides since the World War that already we hear of the use of new techniques in the treatment of wounded in the present war Recently, at a meeting of the Military Surgeons of the United States, Col Gustavus H. Blech suggested that American Army Surgeons will in future use radio-knives on army wounded instead of scissors and scalpel This method is particularly advantageous for wounds of the extremities

"I am sure." Col Blech said, "that in the light of recent experience we should not only provide regimental surgeons with adequate surgical equipment but simplify the scheme of organization for field service by having fewer units but those to be staffed and equipped for all surgical operations permissible in the zones of combat "

NERVOIIS

Faulty Sugar Chemistry

May Cause Mental Diseases

FAULTY SUGAR chemistry in the body may be one cause of mental and nervous diseases, Dr G Wilse Robinson, Jr, and Dr Prior Shelton, of Kansas City, Missouri, recently reported in The Journal of the American Medical Association Patients on the verge of a nervous or mental breakdown might, therefore, be helped by treatment of such a condition

Signs of sugar disturbance that could be considered diabetes were discovered by these doctors in a high percentage of patients when first admitted to a hospital for mental disease From one third to nearly two thirds of the patients appeared from the tests to have diabetes The patients were suffering from all types of mental and nervous diseases, including alcoholism. Tests on these patients several weeks after they entered the hospital showed normal sugar chemistry in one fourth to one half of the group, although only one patient was given treatment for diabetes. From their studies, the doctors

conclude that faulty handling of sugars and starches is common in nervous and mental patients and that it may be a cause of the abnormal nervous and mental con-

SIDE VISION

Eyesight Measuring Device Detects Unsafe Motorists

A DEVICE developed by the American Optical Company detects faulty side vision. For safe driving, one should be able to see a moving ob-



ect at an angle of 90 degrees while his eyes are looking directly ahead The perimeter instrument shown in our illustration measures accurately the entire field of vision. It also is used in the diagnosis of eye and brain diseases.

PINK ELEPHANTS

So It Wasn't Primarily

The Drinking

ALCOHOL is "not the principal factor in the production of delirium tremens." three Providence, R I., physicians, Dr. Hugh E. Kiene, Dr. Robert J. Streitwieser, and Dr. Himon Miller, seem to have proved in experiments reported in The Journal of the American Medical Association, as reported by Science Service

Vitamin B, banished the pink elephants in short order, twice as fast as usual, even though the patients in their experiment continued to drink a quart of whisky daily. These five patients were seeing every animal in the Barnum and Bailey outfit, according to one of them, when admitted to the hospital They recovered, on the average, in 24 days on a treatment of large doses of vitamin B,, plus a drink of four ounces of bonded rve whisky every three hours, day and night.

Signs of kidney irritation in two of the patients disappeared within three days under the vitamin treatment, even though the patients were continuing their daily quart of whisky-from which the physicians concluded that vitamin B, acted directly on the kidneys in such a way as to indicate probable curative nowers

The fact that recovery from acute symptoms of delirium tremens occurred practically twice as fast when vitamin B, was injected into the patients' veins, even in the presence of continuous drinking. indicates, the Providence physicians state, that the cause of the condition is primarily a deficiency of the vitamin in the presence of a deranged sugar-starch chemistry in the body

Reason for the vitamin deficiency which brings on the pink elephants is the fact that the person who gets delirium tremens has a habit of failing to "stop for adequate dietary foods in his alcoholic meanderings after the first 12 hours"

PROMISE

New Synthetic Cleansing Agents Threaten Germs

Discovery of the germ-stopping power of modern synthetic soaps and shampoos may provide scientists with a new class of chemical weapons against disease, including tooth decay, according to Science Service Experiments in this direction are now under way at the University of Chicago, by Dr Benjamin F Miller and Dr. Zelma Baker

Three of the cleansing agents, with the trade names Damol, Emulsol-605, and Emulsol-606, are relatively non-poisonous and nonirritating to mice and rabbits They stop the growth of germs in the test tube Their protective action towards experimentally induced germ diseases is now being investigated.

One of the cleansing compounds, Zephiran, is being tried as an antitooth decay weapon The germkilling power of this substance was announced by Prof. G Domagk, of Germany, the man who gave sulfanilamide to the world. Thais of Zephiran by the Chucago scientists showed that it promises to fight tooth decay in two ways by killing germs and by stopping production of lactic acid which, in high concentration, can destroy tooth enamel and thus give decay a chance to start.

The new cleansing agents were developed to meet various special demands of industry More than 1000 of them have been patented within the past decade They have long, chemical names Zephiran, for example, is alkyl dimethyl benzyl ammonium chloride Another, with the trade name of a much advertised shampoo [Drene—Ed] is trethanolamine lauryl sulfate One of them is sulfonated castor oil

RISK

Dangers From Hormones

In Some Cosmetics

DANGERS besides the possible development of cancer may result from indiscriminate use of sex hormones and vitamins in cosmetics, Dr Joseph Eller and Shirley Wolff, of New York City, warn in a report in the Journal of the American Medical Association Dr Eller and associates point out that a commercial face cream containing a female sex hormone produced cancer in animals as well as other prodund changes when applied on the skin in one fifth of the amount recommended for daily use by women

SOFT CORNS

Operation on Toe May Be Needed

BONE-CUTTING operation for relief of soft corns has been devised by Dr H B Macey, of the Mayo Clinic The snatomy of the fourth and fifth toes make deal conditions for the development of pressure on a bony prominence which leads to calcus formation, proceedings of the condition of the co

One of the bones of the fourth toe often ends with a bony prommence or bump pointing toward the fifth toe The opposite bone of this toe may also have a prominence Short, narrow-toed, forward-pitching shoes may cause one if not both of these bony prominences to press on the flesh between, with a callus resulting

To relieve the condition, the prominent portion of the bone of either toe may be removed by operation. The prominence must be removed smoothly and cleanly so that no sharp points are left to cause further trouble.— Science Services.

ARCH SUPPORTS

Scientifically Correct.

Made of Plastic

LIGHTWEIGHT and sanitary arch supports designed for foot comfort and scientific precision in correcting ailing feet won a major award in the Scientific group of the Fifth Annual Modern Plastics Competition sponsored by Modern Plastics Magazine

Designed by S Sydney of the National Foot Appliance Laboratory, New York, these arch sup-



Plastic arch supports, shaped over plaster of Paris impressions, can be made in any type, or with metatarsal combination

ports are made from a plaster of Paris impression of the foot as taken in the practitioner's office of the physician or chiropodist (podiatriat). Sheets of Tenite II are molded by Insulation Manufacturing Company and from these sheets pieces are cut to size. Under heat and pressure they are shaped into supports that are odorless; low could ductors of heat; resistant to discoloration, tarriish, stains, and moisture; and that do not warp.

Any type of arch support can be made by this method

People allergic to steel or leather will find these plastic arch supports to be the solution to their problems of irritation and skin disorders Smooth and pleasant to the touch, the surface will not tear sheer hose

LOWER MORTALITY

From Intestinal

Ailment

INTESTINAL obstruction has long been one of the most serious disorders of the digestive organs, with a mortality rate which has remained at approximately 40 percent for more than 50 years. Today, however, says Dr. William Osler Abbott, of the University of Pennsylvania Medical School, marked success in treating this condition is being achieved through a variety of ingenious new methods, and mortality rates in several large hospitals have failen to 7½ and 11 percent

SURGICAL RAYS

Ultra-Violet Lamp

Aids in Cataract Surgery

HERE'S good news for persons slowly going blind from cataracts. Greater efficiency in cataract surgery has been made possible by the development of a new ultra-violet lamp for use in cataract cases where the diseased lens of the eye has to be removed by operation.

The new lamp, developed by the American Optical Company in collaboration with Dr. Ehott B. Hague, noted eye specialist, is dirst one designed exclusively for cataract surgery. It provides the greatest source of fluorescing ultra-violet now available for cataract operations, which comprise approximately 25 percent of all eye operations.

The lamp projects a full beam of ultra-violet light of maximum intensity at 3650 Angstrom units Directed into the eye, this light causes the crystaline lens to fluor-esce. As a result, the lens becomes brilliantly visible, a distinct help in cataract surgery. Furthermore, the lamp insures total extraction of the lens as any remnants, which may later cause trouble, are easily located because of their fluorescence, and extracted.

What Is On Venus?

Newest Evidence Hints Venus is Clothed In Dense Clouds of Polyoxymethelene Hydrates

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Moun

ENUS-the most conspicuous of the planets-is in many ways the most disappointing to the astronomer. The casual visitor to an observatory, enjoying a daytime telescopic view of the planet near the time of its greatest brightness, is likely to exclaim with delight at its brilliance, its whiteness, its crescent phase If he is a little more sophisticated, he may notice the beautiful gradation of light between the limb and the terminator. The experienced planetary observer looks at the same view with something very like despair The surface is white, smooth, and usually altogether featureless, except for the diminution in brightness resulting from the increasing obliquity of incidence of the Sun's

Faint and fugitive markings have often been reported by visual observers More contrast is shown on photographs made with ultra-violet light, as Ross showed in 1928, but, even then, the difference in brightness between the lightest and darkest spots is only about 25 percent. These markings change radically from one night to the next, and are obviously phenomena belonging to the planet's atmosphere, and not to a permanent surface.

When the planet is very nearly in line between us and the Sun, so that her apparent crescent is reduced to a mere hairline of light, a strange thing happens We might expect this line to extend over a semi-circle, fading out to nothing at the ends, but, when the sky is clear, it has been seen many times to extend over more than a semicircle. This obviously could not happen on a bare spherical body like the Moon. It must be due to twilight-the illuminated atmosphere visible beyond the place where the sunlight grazes the surface itself Indeed, when Venus is within a degree or so of the Sun which happens rarely—she has been observed on several occasions as a luminous ring—the sunlit atmosphere being in sight all around the dark face.

From the amount of the extension of the horns, it is possible to calculate the height above the planet's surface to which the visible sunlit atmosphere extends, and this comes out only a little more than one mile This is, however, not the full height of the atmosphere, but that of a hazy layer, which is so brightly lighted by the Sun's rays that it can be seen through the brilliantly illuminated foreground of our own atmosphere, close to the Sun.

When Venus can be observed on a dark sky, 20 degrees or so from the Sun, and yet appears as a narrow crescent, we might expect the twilight effects to be more extensive. Something of the sort was recorded by Schroeter, an enthusiastic observer at the end of the 18th Century, and his observations appear never to have been repeated with modern telescopes. Here is a nice problem for an amateur-provided that he has an instrument of considerable size with a field free from scattered light. and lives where the air is, at least sometimes, transparently clear.

THE reflecting power of the surface is high—about 50 percent. When allowance is made for the changing distance from the Earth, it is found that the diminution of brightness with phase, from full to half to crescent, is much smaller than for the Moon. This shows that the surface is relatively smooth. A study by Gerssimovic shows that these two things can be satisfactorily explained if the surface is covered by clouds or fog—consisting (like terrestrial clouds) of particles larger than the wavelength

of light, but can not be accounted for by reflection from a solid surface or from a thick layer of cloudless gas.

The rotation period of Venus is still unknown, except that we are sure that it must be long. The markings change so much from night to night that they can not be followed: and observations for radial velocity, which alone suffice to reveal rotation for all the planets from Mars to Neptune, show here only that the motion is too slow to measure It appears certain however, that Venus does not keep the same side turned permanently toward the Sun. Radiometric measures at Mt. Wilson and Flagstaff show that the dark side of the planet radiates considerable heat: but, if it was always dark, it would be very cold. It is probable that the planet's "day" is several weeks long by our reckoning.

Evidence regarding the composition of the atmosphere can be obtained only with the spectroscopeand our powers of analysis are seriously restricted in the case of a cool body like this We must observe through our own atmosphere -which cuts off all the ultra-violet except a beggarly part near the visible region. All the really strong absorption bands of the familiar gases lie in the maccessible part of the spectrum For a few of these there are feebly absorbed bands in the observable part of the spectrum, demanding many thousands of times more material to produce than the others, but for many of the best-known gases-for example, hydrogen, nitrogen, carbon monoxide, helium, neon, and argon -there is no accessible absorption at all, and we cannot detect them The exceptions fortunately include just the constituents which are of the most general interest-oxygen. water vapor, and carbon dioxide

The first two of these are present in our own atmosphere, and disturb observations of the planets seriously, but the difficulties, though troublesome, can be surmounted. Venus, with her great surface brightness, is the most favorable of all the planets for such a test. Yet the observations of St. John and Nicholson, at Mt. Wilson, failed to detect any observable absorption by either. For oxygen, the test is sensitive, and the observers conclude that the amount above the surface of Venus must be less than a thousandth part of that in our atmosphere. The test for water vapor is much less delicate, and an

amount much less than a tenth of that on Earth (above a mile-high mountain in dry weather) would have escaped detection.

Carbon dioxide, however, gives bands in the infra-red, discovered by Adams and Dunham, which, though not very strong, indicate that the amount of this gas above the planet's surface is equivalent to a layer about a mile thick, at standard temperature and pressure—about 400 times more than here.

On Earth, however, carbon dioxide is continually being removed from the air by the growth of plants, which use the carbon in building their own substance, and turn back the oxygen. On a lifeless world, we might expect to find far more carbon dioxide, and little or no oxygen, so that this is no puzzle. But the absence of water is hard to account for. The sunlit side of Venus must be hot, especially as the carbon dioxide in the atmosphere must serve as a very efficient heat trap; and it appears probable that the temperature of the planet's visible surface is not far below the boiling point of water, or higher. The solid surface below the visible clouds or haze must be still hotter. If there were oceans on Venus, or any considerable, though smaller, quantity of water. its evaporation would saturate the atmosphere with moisture, and cause the appearance of watervapor absorptions in the spectrum, much stronger than those produced by the Earth's atmosphere.

Venus is so nearly a twin of the Earth in size and mass that it is very hard to understand how she could have practically no water, while our planet is almost drowned in it. No satisfactory explanation has yet been suggested, yet the train of evidence which has just been sketched is so strong that we appear, at present, to have to accept it as a fact

But if there is no water on Venus or practically none-what produces the great veil of whitish clouds which covers her whole visible surface? A very interesting suggestion has just been made by Wildt, pointing out possibilities which would never have been thought of by astronomers less familiar with chemistry.

Start with the assumption that the atmosphere of Venus, long ago, contained a great deal of carbon dioxide (it is still there), a small amount of water vapor (for the reasons just stated), and little or no oxygen. The temperature of

the surface was, and is, high enough to make the appearance of life very improbable. The surface of the planet, if of composition like terrestrial rocks, would contain partially oxidized (ferrous) compounds of iron, and these, if there was any water present, would undergo weathering and exhaust



A photograph of Venus, made by Harold A. Lower, using a small telescope as a camera. Many are surprised, on their first view of Venus through telescope or opera glass, to discover that its disk is not round but shows phases, as does the Moon. Indeed, there are persons who claim they can even see the halfmoon appearance of Venus with the unsided eye (the smallest glass renders the phases clearly visible). Perhaps the fact that such persons know what to look for to some extent influences this belief. Galileo was the first of record, however, to have seen them, using his first telescope. Copernicus had predicted them

from the atmosphere what little oxygen remained, leaving the carbon dioxide and water vapor.

These gases, when exposed to short-wave ultra-violet light, enter into the reaction

CO₂ + H₂O = CH₂O + O₂ forming formaldehyde and free oxygen. The considerable amount of energy required is furnished by the light

Formaldehyde, while reactive chemically in many ways, is highly resistant to attack by oxygen. Hence it is possible that, while the oxygen is used up by further rock weathering, the atmosphere may contain steadily increasing quantities of formaldehyde gas If so, Venus would be a very poor place for men in some hypothetical for men in some hypothetical poisoned at once.

But a test of this hypothesis is available. Formaldehyde exerts a very powerful absorption upon ultra-violet light, producing a system of bands extending up to λ3600 - that is, well into the spectral region which we can observe through our atmosphere Dr. Wildt, during a recent stay at the McDonald Observatory, obtained a series of ultra-violet spectra of Venus, and of the Moon for comparison. Careful comparison of the two showed not the slightest difference in the spectra of the light reflected from the two bodies. If there had been an amount of formaldehyde in Venus' atmosphere enough to make a layer of the gas a quarter of an inch thick, under standard conditions, its absorption could have been observed.

One would think, then, that this theory must be abandoned, but here is where more chemistry comes in Formaldehyde has unsaturated molecules, which have a strong tendency to link themselves up into long chains-indeed this makes it an important raw material for the production of some commercial plastics. Even in the pure state, it condenses into a solid white mass-probably consisting of a complex mess of longer and shorter chains Water-vapor catalyzes the reaction If a small amount of it is injected into absolutely dry formaldehyde gas, the reaction vessel is instantly filled with a dense white cloud of finely divided solid particles If heated hot enough these polymerized hydrates are dissociated into their constituents; but this requires a temperature of about 200 degrees Centigrade At the temperature which probably prevails on Venus' surface, there would be little decomposition-which may account for the absence of the formaldehyde bands in the spectrum

It seems, then, to be quite possible that the very absence of abundant water from the planet's surface—if in presence of abundant carbon dioxide—may lead to the production of white clouds on its atmosphere, and the precipitation of of white polymeric compounds on its surface, and so account for its telescopic appearance

Dr. Wildt presents this reasoning tentatively, as a possible explanation. It is very interesting to see how results obtained by chemists, with not the slightest thought of application outside their own science, and published in journals that not one astronomer in a hundred thinks of reading, may, years afterward, offer a clue to an outstanding astronomical puzzle — Princeton, October 2, 1940

Protecting Gasoline Tanks

Principles and Practice In Development of Bullet-Proof Tanks for Airplanes

ALEXANDER KLEMIN

viation Editor, Scientific American n charge Daniel Guggenheim School f Aeronautics, New York University

HEN the Army Air Corps announced a few months ago that it had secured a leak-proof or bullet-proof gasoline tank, old timers in aviation were astounded -because they had known and used protected tanks at least 15 years ago Protection for tanks was news only to the younger personnel of the Air Corps But if the protection of tanks is an old story, the scientific principles involved may not have been clearly understood hitherto Accordingly, a paper by A R Weyl, in the Journal of the Royal Aeronautical Society. entitled "Fire Protection of Petrol Tanks," which does go thoroughly into principles, has been well received on both sides of the ocean The Weyl paper is based on systematic research work with the aid of slow-motion cameras and other devices of modern ballistics

Here are Mr Weyl's general conclusions regarding tank design

The entry hole made by a builet is harmless, and no ignition is connected with the entry It is quite easy to seal the entry hole made by a bullet. The exit hole or leak made by a bullet which has passed through a tank is much larger and is much more difficult to seal. The motion of the bullet inside the gasoline produces pressure waves and it is the pressure waves which are the cause of the exit leak and help to produce ignition. If the bullet can be made to stop within the tank no ignition may be expected If the bullet can be separated from the gasoline while inside the tank, the exit leak will be small If the bullet can be freed from gasoline at the moment when it is leaving the tank, no ignition should take place Incendiary bullets designed to disintegrate inside a gasoline tank are unlikely to cause ignition

These general principles are of real value but Mr Weyl goes beyond principles and gives some thoroughly practical design suggestions

It is important to concentrate the gasoline of an airplane in one very compact tank. Then there is less surface for bullets to strike, and the weight of tank protection is smaller because the compact tank has so much less surface in relation to its volume.

What metal should be used? There does not appear number reason to choose one metal over another. Brass offers slightly higher resistance to the impact of pressure waves because of its elasticity Magnesium tanks suffer large holes, but their edges are not deformed On the whole, one metal will do almost as well gas another.

To restrict the pressure waves, it is important to have baffle plates. How can the baffle plates be arranged inside the tank so that all likely hits are faced by them? A star-shaped arrangement of baffles seems adequate but heavy

Since pressure waves cause the dangerous exit leak, the tank mounting is important. If the mounting is too soft, resonance is to be feared But above all, the support of the tank must be well distributed, the internal pressure waves are then less likely to cause trouble Further, the tank should not be mounted in brackets, but in a cradle or straps

Is it any help to use hollow containers or compartments within the tank? That might be helpful, since the pressure waves could destrothe internal compartment without the outside walls being affected. Filling of the protective compartments with inert gases was found to be useless, however.

Here, in general, is the proper way to protect the tank Around the metal there is fitted a gasoline-tight fabric, treated skin, or parchment Then a fairly thick layer of sealing compound which swells under the action of gasoline and fills the entry and exit holes. Since

the sealing compounds have no strength a sealing bandage must come outside of all this in the form of highly elastic vulcanzed rubber. The compressing rubber cover helps to separate the bullet from the gasoline in accordance with one of the principles given above. The whole structure should be enclosed in a wire net of a large mesh which is electrically connected with other metallic parts of the aircraft to prevent electrical junition effects.

Of course, superimposed upon all these requirements, will be the final requirement that the protection of the tank must not be so heavy as to impair the general load-carrying capacity of the airplane. Otherwise military autorities might decide that it was better to have a lighter, more maneuverable airplane and to take a chance on the bullets piercing the tank.

HYDRAULIC TESTING

Destruction of Airplane Parts Reveals Defects

ESTING to destruction of the structure of airplanes dates well back in aviation, during the World Wart the Army Air Service, with the aid of French and British missions, converted into an art what used to be a crude shop test Today, the structural testing of wings and fuselages is as useful as ever, and methods are highly refined

Charles Tilgner, now Chief Aerodynamicus of Grumman Aircraft, has been responsible for great progress in "hydraulic testing" Loading sandbags or shot-bags weighing thousands of pounds on the wing is a painful, slow process, which may be dangerous when the structure suddenly lets go and

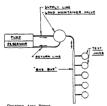


Diagram of the system of testing sirplane parts hydraulically



Using hydraulic jacks to test

heavy bags fly downward Another drawback of the sand-bag or shot-bag is that if loads are not applied simultaneously, secondary stresses and inaccuracies may be introduced Mr Tilgner has developed a method which avoids all these drawbacks, loads are applied to the wing by suitably placed hydraulic jacks. The loads from some of the tacks are also applied through a leverage system, so that a single jack applies a predetermined load to various parts of the wing The jacks are all connected to a single source of supply. as shown in the diagram, and between the pump and the jacks there is introduced a load-maintaining valve in which a weight on top of a piston is used to provide a constant pressure With pump and valve under complete control, and a single source of pressure supply the engineer can be quite certain that he is applying exactly the required load to each part of the structure. Further, the load can be applied and released with rapidity and ease -A K

AIR TRAILERS

Possibility of Transporting

Troops by Air

A CORRESPONDENT asks whether the idea that Germans will tow gluders behind sirplanes to transport troops has any ment! In spite of all the discussion by "experts," no definite answer can be given W. S. Shackleton, writing in The Aeroplane, gives as good analysis of the problems involved as anyone. He believes that such a troop.

train will be practicable. This would consist of four large gliders, each about 82 feet in span and each carrying 20 troops, spaced 100 yards apart and towed behind a large twin-engined transport.

There are many difficulties, however The glider train would be slow and vulnerable. It could not possibly defend itself with gun fire, and it certainly could not maneuver or conduct a dog fight in the sky. There is also some doubt as to what would happen to the glider train in rough weather.

We suggest a glider trailer flight as a spectacular feature for the next Soaring Meet at Elmira—A K

SEARCHLIGHTS

MMENSELY powerful anti-aircraft searchights of the type being used by the British in defending London are being delivered to the United States Army by General Electric Naturally, information is restricted, but we are free to say that the lights are 60 inches in diameter and of 800,000,000 candle-power They are effective for at least 5½ miles in the air, which should be sufficient for sotting most bomber attacks

The searchlight is not new in principle, since a powerful arc with



800,000,000 candle-power

concentrating mirrors has been customary for decades, but besides the extraordinary power of the new lights it has many valuable features Thus, the beam may be directed from side to side or tilted up or down just as easily as a motor-car can be steered Both the lights and the power plants which accompany them are mounted on rubber-tured wheels for easy towing into position or for transporta-ing into position or for transporta-



An airplane finder used in conjunction with powerful lights

tion in tucks. The searchlights are, of course, used with an optical airplane finder. Our photographs illustrate several aspects of these lights. Even though the best anti-aircraft defense lies with interceptors or pursuits, good batteries, well directed, make life very unpleasant for the enemy bombers, these lights should be most valuable in our national defense. A K.

OXYGEN BOOST

Increases Diesel Power

for Take-Off

AIRPLANES require about one third more power in take-off than in flight, and airplane gasoline engines fortunately have higher rating at take-off than in normal operation Against the airplane Diesel engine there has been raised the objection that its power cannot be boosted during take-off

Professor P H Schweitzer, of Pennsylvania State College, writing in Mechanical Engineering, describes experiments intended to remove this criticism. He has tried to increase the power for short intervals by feeding pure oxygen to the cylinder and increasing the oxygen concentration from the normal 21 percent to 45 percent So much extra power can be developed for take-off by this method that the size of the airplane Diesel could be reduced some 25 percent by the "boost" While the oxygen containers are heavy, they are not heavy enough to invalidate the possibilities of the system Now that the laboratory experiments have proved satisfactory, it would be desirable to make an actual test in flight operation -A K

Lightless Light

Black Light—Unseen Rays—Causes Many Materials to Glow, Has Practical Uses

PHILIP H. SMITH

MAGINE a convoy of ammunition trucks speeding along a highway in pitch darkness, holding to the center of the road and following its contours with unerring accuracy, but using no headlamps This isn't a Jules Verne dream It is a possibility, thanks to black light

If you don't care for the warlike, you can choose a peacetime scene Imagine a motion-picture theater having its lobby illuminated entirely by the soft light of glowing walls and luminous statuettes. If you arrive late and the house is dark it is simple to find your seat because a luminous design in the carpet guides you down the asile, and the seat number sparkles in the dark. This, too, is a possibility, and again, it is a black light phenomeron.

The paradoxical name "black light" is given to rays or certain wave hands in the ultra-violet end of the spectrum Roughly speaking, these waves have lengths ranging from 3300 to 4000 angstroms (light measure), 4000 being the beginning of visible light. These invisible rays have the ability to make certain materials fluoresce, or glow, as though they were producing light They don't tan skin or have germicidal properties as one might expect of ultra-violet rays, these properties being possessed by waves of shorter length Fluorescence occurs only in the presence of the rays It is unlike phosphorescence whereby light is stored and given forth after the light source

Black light is no recent discovery, but it has been used indifferently. Luminous costumes have been featured on the stage from time to time Europeans, particularly the Dutch, have developed it to practical ends much more than we have and now the commonplace of blackouts has given it a great boost Today we have available inexpensive black-light sources and a wide color range of paints, dyes, and inks which have been rendered durable through painstaking research

There are three types of blacklight lamps. The simplest type, suitable for amateur work, is a tungsten filament lamp with a black glass bulb Its life is short because of the high temperatures required for ultra-violet radiation The other types are high-intensity. mercury vapor lamps, one employing a black glass bulb, the other, a clear glass bulb with separate black glass filter This last mentioned type is the most practical and widely used commercially. because the filter does not have to be replaced if the bulb goes Mercury is used because its spectrum contains the richest emission of ultra-violet rays in the black-light zone

Look directly at a black-ray lamp and if you see anything it is a core glowing like the heating element of an electric toaster. You will notice that a haze comes before your eyes which is annoying but not dangerous. This sensation is caused by a slight fluorescing of the eyeball. If someone should look at you while you are standing in the rays, they would see your teeth glowing in the dark, provided they are your own teeth. Store teeth will not fluoresce Your fingernails also glow, otherwise you would be practically invisible.

The materials used to make fluorescing paints, dyes, and inks, are more or less trade secrets. There are plenty of substances which fluoresce naturally but it has taken years of experimentation to select them for proper color and durability Today, there is a fair range of colors to be had, and in Europe they go so far as to offer fluorescing materials in the form of plastics, make-up, chalk, and crayons

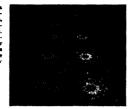
Word's visitors at the New York World's Fair were unaware that they saw a sort of dress rehearsal of black light The night scene in the Perisphere's miniature city was created by coating windows with aftorescent paint and turning on black light as the ordinary light was turned off The luminous bathing caps of the swimmers in Billy Rose's Aquacade were simply colored with fluorescent materials so that they would glow in the rays

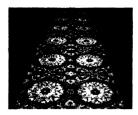




A possibility for fashion shows: An evening dress and wig under ordinary light and black light. The latter causes the dyed design to glow in colors

At right: A carpet in a theater aide as it appears when lights are on, and glowing under invisible ultra-violet rays. Below: In complete darkness, steps in another side are easily seen as black light makes the dyes of the carpet glow







tered from direct sunlight because the fluorescent properties are impaired by the sun's rays As luck would have it.

many inexpensive dves are fluorescent A ten cent handkerchief is very likely to become a thing of rarest beauty in the rays of black light Dyed fabrics can be used for stage curtains and costumes and now there are carpets woven from materials given fluorescence with dyes One wonders what the effect will be upon theater audiences if black light becomes common Fluorescent carpets already are used in 25 theaters Must the theater-goer of the future consider dressing for two lighting effects?

This is a fair question, because the practice of marking fine fabrics with invisible fluorescent inks is being carried on by some laundries and cleaners, and as a result Mrs. Jones is known to have been de-coded as she walked down a theater aside—late to the performance. If this simple scheme to avoid ugly laundry marks leads to trouble, more can happen. We know that some rouges go dead black under the rays; we have yet to find out about har dive

to man our soout nair dyes
Circulars printed with fluorescent inks are being used to show
prospect the possibilities of lighting equipment for advertising
purposes, and the properties of the properties
that's the daytime appearance;
then, by switching on black
light, the circular shows signs and
building walls glowing with the
effect of night reality. It is conceivable that books and magazines will be printed in such links
for those whose eversitet can be

helped by illuminated lettering Black light has moved into the field of fraud detection. It can be used to reveal alteration of documents either by showing the work of ink eradicators or differences in inks Still in its infancy is the detection of frauds in antiques Suppose, for example, you possess a pair of glass candlesticks with dangling prisms. If the two are not contemporary or some of the prisms have been lost and replaced, the substitution is easily detected Glass is fluorescent-particularly cheap, modern glass which contains uranium salts-and glass from different sections of the country and of different manufacturing eras, rarely if ever fluoresce with identical color.

O Lb tapestries and fabrics lend themselves to black-light check If there has been mending it will be revealed, because old and modern dyes are readily distinguished in black light. Even furniture can be examined for antiquity because old-fashioned glues fluoresce quite differently from modern ones

Sam Hibben, one of the fathers of black light, tells of purchasing a sandstone fossil of a crustacean while traveling as a boy not Mustra, and of proving its genuineness with black light many years after The fossil came under the rays quite by accident and to his surprise it glowed brilliantly. The explanation is not hard to find. Fluorescence had not dimmished with age and this crustacean displayed it just as do the skin and bones of fath.

Before black light becomes a reliable tool for testing antiques, standards will have to be established Your candlesticks, for example, may not be a matched pair, but which is new, which is old which is the fake and which the genuine? Perhaps both are genuine, differing only as to place and

of concealed lamps. Both these spectacles demonstrated the possibilities for achieving dramatic light and color effects

Fluorescent wall paints are now in commercial use. Common practice is to paint walls in designs which will look well under all lighting, but glow luminously in desired color combinations under black light and give sufficient light for seeing. It is particularly well suited for the soft lighting of cocktail bars and lobbies. There are paints which show only in daylight; others which respond to both daylight and black light, and a third type which has color only under black light. By a judicious use of these three types in combination, some striking effects can be produced. You'll soon see advertising displays which have a dual aspect created by the alternate flashing of ordinary light and black light. For the time being these will be used indoors or shel-



Several types of black light lamps. Two, of clear glass, stand beside reflector and hood of black glass. A self-contained lamp, at right of center

time of manufacture Repairs to glass, furniture, and fabrics can be ascertained, but experts will have to struggle long before they are able to place an object definitely within a given period

In Holland, black light is used for sorting diamonds It reveals source of origin rather than qual-Some diamonds fluoresce brightly, others only very little If you should examine a bracelet of diamonds under black light you would find few of the gems glowing alike Some other odd but practical uses to which the Europeans have put black light are to ascertain adulterations and food quality. Butter can be distinguished from margarine because the former fluoresces vellow, the latter pale mauve, fresh eggs fluoresce red while stale ones are brown

There is a very broad field in mineralogy One can distinguish many minerals in mines under black light, and companies are already using it to search out zinc and tungsten deposits— to find the richest ores and to examine scrap piles for valuable minerals discarded in error By ource chance. most of the really valuable minerals and metals fluoresce. It is possible to distinguish genuine sapphires, pearls, and ivory from the artificial, to tell new cut jade from old, and to spot rubies from Siam as contrasted with those from Burma or the synthetics.

VERY simple application of black A light has recently been placed on the market. It calls for coating reflectors with a substance which fluoresces red, and when used in combination with mercury lamns. a pink tint is added to make up partially for the red-ray deficiency characteristic of the mercury spectrum. Even more ingenious is the weaving of a fluorescent strand into rope, as now practiced by one manufacturer This simple trick makes possible checking up rope which fails in use to see whose product is at fault-the ingenious manufacturer's or a competitor's

Experimenters have been trying a variety of stunts to test out black-light possibilities One of the most novel has been to play cards with no illumination other than that furnished by a tablectoth of

fluorescent dyed fabric and cards printed in fluorescent inks It is significant only in demonstrating how objects themselves can be made a source of light-an idea very likely to be capitalized upon Now that fluorescent substances can be incorporated in plastics, the idea gets a real boost. The plastics can be formed into figurines and statuettes, into artificial flowers, and into threads for weaving into fabrics, and all these supply what might be termed artistic, indirect lighting fixtures, though the light is only a glow

Of military uses for black light. little can be said because nothing is known officially But one can hardly mull over the great advantage of invisible light under wartime conditions without having some uses come to mind. The convoy described at the beginning of this article finds its way by flashing black light on fluorescent painted markers lining the roadway, and that's just one step ahead of the present practice of using prismatic buttons Gages and controls of artillery and aircraft can be illuminated in such a manner as to be invisible to the enemy. And perhaps this is being done. The Germans must know plenty about black light because they control the Netherlands, the seat of blacklight development

Both fluorescence and phosphorescence are being used in England The London bobbies have crossed suspenders which show up in the darkness of blackout traffic The entrances to air raid shelters are indicated by fluorescent mark-



"Democracity" in the Perisphere at the New York World's Fair. The effect above at left was achieved wholly by use of fluorescent paints on the city and



black lights overhead, not a single inch of wiring being in the city itself. Above, at right, the tiny city and surrounding country under ordinary light

ings, or with phosphorescent paint Black light sounds like the light the little man who wasn't there reads by, but for all its paradoxical nature it has a valuable role to play in the future. First and foremost, it affords an opportunity to achieve color and light effects by ullumination which cannot be obtained by any other means In time, decorators may have to think in terms of two lighting effects. It already serves industry, but here the possibilities have no more than been scratched. The lamps and fluorescent maternals are available and practical and it remains only for man's ingenuity to put them to varied esthetic and commercial uses

notographs courtesy of Calco Chemical Co. iszander Smith & Sons Carpet Co., Stroblite Co. estinghouse Elec. & Mig. Co.



Peep holes enable operators to observe first stage of process

Carbolic From Gases

World's Largest Synthetic Phenol Plant Is Operated By Only Six Men

ANY plastics employ phenol, better known to the layman as carbolic acid, as one important constituent Since the year 1834, phenol has been made from coal, an enormous amount of by-product being produced for every pound of phenol The plastics industry has grown so fast, however—from a production of 2,000,000 pounds in 1921 to more than 200,000,000 pounds in 1939—that it has become necessary to synthesize the basic materials used in their manufacture.

Of great interest, therefore, is the new \$2,000,000 plant built at North Tonawanda, New York, by Durez Plastics & Chemicals, Inc., for the production of synthetic phenol from several common chemicals. When the acid is made by the new Raschig process, the by-products amount to less than one-tenth of a pound for each pound of phenol The plant, the largest of its kind in the world and

the only one in the United States, is one of the most amazing chemical units in the world. In spite of its size and the intricate processes involved, it can be operated at full capacity by a force of six men and a supervisor for each shift Operations are controlled automatically hy these men at master control panels In case of motor trouble anywhere. automatic signal divisions warn the operators who can then cut in duplicate



Vapor superheater temperatures are controlled at this station

equipment from their control sta-

There are several large buildings, towers, and distillation units, all joined with 40 lines of pipe, three miles of which is made of glass, porcelain, or rubber to withstand the action of acids at high temperatures. Duplicate equipment has been installed at every stage for use in case of trouble.

stage for use in case of trouture. The process itself is so intricate that many leading chemical engineers in this country refused to consider it when it was first offered here a few years ago. Briefly, it consists, first, in passing a vapor mixture of benzene, hydrochloric acid, and air through a catalyst. This produces a mixture of chlorinated benzenes from which mononated benzenes from the



One section of the distillation building showing chlorobensene stills. Duplicate pumps assure continuous operation regardless of breakdowns



Portion of the intricate glass pipe manifold on top of the acid recovery tower Here the Raschig carbolic acid process starts in the second stage

chlor-benzene is distilled in the pure state for use in the second step, a vapor mixture of mono-chlor-benzene and steam is passed through a catalyst which produces phenol and regenerates the hydrochloric acid These two stages actually form a completely continuous process, and during the process most of the materials formed, and the catalysts, are recovered for re-use The process can be likened to a game of ring-around-a-roses, the process

making a continuous circle with the phenol being extracted or drawn off as it is formed, and new materials and new catalysts added as the original ones wear out or become used up

Assuring an independent and controlled source of the purest phenol obtainable in this country (above U. S. P. standards) this new plant not only makes possible improved plastics but also is a definite aid in national defense, for phenol is used in some explosives

ordinary natural gas if allowed to return to its natural state, and all of this would take place without any change in the gas. Thus, a big gas holder can store 15,000,000 cubic feet of gas but it would take a holder of only 25,000 cubic feet capacity to store the same amount of gas in the liquid state. This saving in storage space had such great appeal that Mr. Clark and Mr. Miller began extensive experiments as far back as August. 1937. to solve the many problems of economically liquefying and storing natural gas

These experiments revealed that the most practical method of liquefying the gas was by the so-called "cascade" system in which the gas is cooled to the liquefying temperature by passing it through four stages, each one of which is surrounded by a closed circuit containing liquids having successively lower and lower boiling points.

The Cleveland plant will be able to liquefy 4,000,000 cubic feet of natural gas each day and will have three storage tanks, each holding 600,000 gallons of liquid natural gas, which will be equal to a total storage of 150 million cubic feet.

Not least in interest is the way in which this liquid is reconverted into gas. This requires steam heat, and the natural gas is boiled at a speed fast enough to produce 3,000,000 cubic feet of natural gas per hour, enough to supply cooking needs of 100,000 families

NATURAL GAS STORAGE

Changed To Liquid, Stored in Smaller Tanks

Ist dream of J A Clark and R W. Miller, of Pittsburgh engineers of the Hope Natural Gas Company, of reducing natural gas to the liquid state and then storing it at 250 degrees below zero, has come true in a new plant now being erected at Cleveland for The East Ohio Gas Company. The tanks holding the liquid gas are of special nickel steel and are insulated by walls of cork three feet thick.

Even metals lose their strength at sub-Arctic temperatures. The problem of storing liquid natural gas, therefore, involved research and experiment to find materials which would withstand the harrowing cold of the liquefied fuel. The reason for this interest in liquid natural gas is not hard to find because natural gas companies have experienced considerable difficulty in solving the problem of varying gas demands by consumers Generally, the natural gas supply and the consuming center are miles apart, joined by a pipe line Economic reasons dictate the size of such lines, and they are used only at part of their capacity in the summer time, at best.

Sometimes gas companies solve their storage problem by raising the pressure of gas in the pipe line, making this a natural storage reservor, but it is a limited one. Other companies have used high-pressure storage tanks, but these are expensive and rather uncommical ways of storing large volumes of gas

One cubic foot of liquid natural gas would make 600 cubic feet of

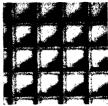
POWDER SCREEN

No Wires, No Weaving in Powder Metallurgy Product

Power metallurgy, which was discussed in length a few months ago in Scientific American, has solved many industrial production problems. It has now been adapted



Powder acreen, natural size



Powder screen, 6x

by the Chrysler Corporation to the production of fine bronze screens. The resulting screen, shown in the accompanying illustrations, is, as yet, only a laboratory curiosity. It is, however, practical from the standpoint of both use and manufacture.

This screen was made of finely powdered copper and tin, processed and molded into finished form without the necessity of first making wire and then weaving it into the required pattern.

ANOTHER SYNTHETIC

"Rubber" Made From

By MAKING It as a chain of molecules to which only a very limits of number of additional links can be added, American chemists have been able to produce from oil refinery gases, formerly wasted, a synthetic rubber-like substance with many advantages over imported natural rubber

Dr. Per K Frolich, director of the chemical division of the Esso Laboratories, recently gave the first technical report of the new "butyl rubber," developed by Standard Oil chemists. It is colorless, odorless, tasteless, and more stretchable than rubber from trees. —Science Service

COLD-SET GLUE

Easy to Use, Water-Proof,

Strong

What is said to be the first coldsetting resin adhesive ever produced in the United States has been announced by the United States Plywood Corporation. Called Weldwood plastic resin waterproof glue, the product is bacteria-proof. rot-proof, stain-free, and economical, as well as water-proof and enduring. It is made under Plaskon natents.

The new glue can be used by professional or amateur. It comes as a finely divided powder which dissolves instantly in cold water and is ready to use immediately after mixing Jobs can be handled within two hours after gluing and can be worked after four hours. Since it sets by chemical action instead of evaporation, continuous submersion of the glued part results in no deterioration. It dissolves only in the presence of alkahs or acids that are strong enough to eat away the wood itself, or under heat above 160 degrees, Fahrenheit.

The manufacturers claim great economy in the use of this glue, as



Rock maple, joined with coldset glue, broke; the joint held

they advise the thinnest possible coat on the surface to be joined, the coating being applied by a spray or by a brush and then squeegeed Because of the small quantity of water used, shrinkage of dowels or close joints is minimized.

SMOKE ROUTER

Reduces Air Pollution

By Smoke Stacks

A QUEER device that bombards smoke with high-frequency sound waves, thereby causing the smoke to lie down and play dead, is being developed by the United States Bureau of Mines. The idea is to attach one of these units to every chimney and stack, and prevent the smoke from getting out and spreading around the countryside.

Inside a piece of pipe is an aluminum cylinder which is connected at one end to a loud speaker and special radio set. The radio sets up a magnetic field which causes the aluminum cylinder to vibrate, producing powerful high frequency waves. These waves are directed at the smoke and cause the particles in the smoke and cause the particles in the smoke to coagulate into relatively large pieces of soot which fall out of the air stream by gravity.

It's still an experiment, but has possibilities of doing much to reduce air pollution by smoke, if it can be applied to large-scale service.—Aluminum News-Letter

HOOK-ON METER

Volt-Ammeter Snaps

Over Wire

A VERSATILE, portable instrument, a hook-on volt-ammeter for measuring alternating current and voltage, has been introduced by the General Electric Company, With it, alternating current can be read instantaneously on both insulated and non-insulated conductors simply by hooking the instrument around the line For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumbmanipulated selector switch to the desired voltage position on the scale

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs Weighing only 3½ pounds, it is designed for easy, one-hand operation. Four current



Using the hook-on meter

ranges—0-15/60/150/600 amperes—and two voltage ranges—0-150/600 volts—are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 percent.

An integral part of the instrument is a C-shaped, split-core current transformer so designed that it can be operated without a trigger. To make measurements, the transformer is simply pulled open and placed against the conductor

A slight push on the handle snaps the transformer shut The measurement completed, a gentle pull springs open the dovetail joint of the transformer and releases the conductor The dovetail joint assures that particles of dirt, which would cause large errors in the ordinary but Joint, have almost negligible effects on the indication

CIRCUIT BREAKER

Small, But Does

A Big Job

A SIX-OUNCE electric "safety valve" was recently announced by Westinghous Not only does this hard-boiled midget switch stop force equivalent to 230 horsepower, but it does it in a way that is entirely new Representing an adaptation of principles involved in the design of a superior type of circuit breaker for airplanes, this device is intended to guard the lighting and appliance circuits of homes and industry

Although it is not much larger than a woman's compact, the device is able to interrupt a short-circuit current as great as 5000 amperes, shutting off the flow of electricity



Midget circuit breakers and woman's compact; compare sizes

through it in less than one sixtieth of a second

Paradoxically, this unique circuit breaker permits the passage of momentary "overloads" of electric current, which normally occur when motor-driven appliances are started, but it also operates instantly to shut off the current if the overloads become dangerous.

This dual personality is due to the use of both heat and magnetism to operate the breaker. When lights or appliances are switched on, the flow of current through the contacts of the breaker gradually heats a bimetallic strip inside the unit Since one of the metals in the strip expands faster than the other, the unit eventually bends, releases a latch, and breaks the circus.

The bimetallic strip has been designed to permit a safe amount of "overload" to pass through it before opening the breaker However, of the current increases beyond a safe margin, it not only causes the bimetal unit to trip but causes a safe margin, it not only causes the bimetal unit to trip but causes a latch and open the breaker instantial to the safe and the safe

MIRACLE MEASURE

Finds Thickness of Paint

To Hundred-Thousandth of Inch

MEASUREMENTS to less than onehundred thousandth of an inch can now be made of the thickness of non-magnetic films such as paint, paper, and even rust or weathering on sheets of iron, reports the Telephone News Bulletin. It is done without disturbing the coating

A short iron rod with two coils of wire on its pressed, end on, against each side of the coated iron sheet Both rods are magnetized by passing an alternating current through one of the coils on each rod This induces voltage in the other two coils The coating, which is non-magnetic, decreases the voltage on its side of the sheet by an amount which depends on the thuckness of the coating

This method, developed recently by the Bell Telephone Laboratories in New York, has many uses in the telephone industry, where tests of the condition and wear of a vast amount of indoor and outdoor equipment are being made constantly to improve the service.

BUBBLE DANCE

In Oil Circuit Breaker

Aids in Design

Moving pictures have revealed to engineers of the Westinghouse Research Laboratories a "bubble dance" of elusive electric arcs Drs. Joseph Slepian and Thomas E. Browne, Jr., were seeking ways to improve the design of oil circuit



With this equipment engineers searched for data on circuit breakers, found bubble dance

breakers and discovered that the gas bubble, formed by decomposition of the oil surrounding the contacts, appears to dance as it oscillates from large to small are STE pretures indicate, as a sea of the pretures indicate, as a sea of the pretures indicate, as a sea of the preture in the contact of the con

This discovery of the "bubble dance" is significant for it gives the engineers a suggestion as to the direction the design of oil circuit breakers should take Indeed, Dr. Slepian believes that emphasis should be placed on the de-ionizing (removing of electrification) of the gas within the bubbles

gas within the bubbles
To carry out the advanced
studies necessary in this research,
Dr. Browne built an experimental
circuit breaker with thick plate
glass windows opposite the point
where the contacts separate. Using
a high-speed movie camera which
carried the film forward at a speed
of 50 feet a second, he used a revolving glass prism to move the
image at the same speed. The prism
acted as a shutter, revolving 60,000
times a minute, or about 30 times
the speed of an airplane propeller
during normal flight



INDIUM

ONE of the metals about which you have heard little but which is destined to play an increasingly important role in industry is indium. Broadly speaking it does for non-ferrous metals what chrome does for ferrous ones. It is attractive at this very moment because it has been proved that a very small amount added to bearings composed of alloys of cadmium, silver, tin, or lead, inhibits corrosion due to the organic acids present in the lubricating oils. Indium can be made to diffuse through these bearing alloys by simply coating them and heat treating, and there is no ill effect upon the bond between the alloy and the steel backing. Given the severe conditions under which the modern automobile and aircraft engine operates, indium makes a real contribution and it is no wonder that it has been seized upon to do its bit

The earliest use of indium was to improve the quality of gold alloy castings in dental work. Another use is to lower the melting point of alloys. There are indications that casting alloys can be developed which will soften in hot water, thereby giving the medical profession something for molds. The metal added to tin seems to inhibit the phenomenon of "tin pest'

Like many of the other lesser known metalsberyllium, tantalum, molybdenum-indium was extremely costly at the outset of its use. From \$300 an ounce, it has dropped to \$30 for the electrolytically pure and \$15 for other grades Since a pinch of it goes a long way to produce valuable results it cannot be called a prohibitively priced metal Furthermore, there's plenty of it in the country

MORE MILES PER GALLON

There's an added significance given to work to improve bearings when one hears what the engine and fuel people plan for the future Not content to have improved these two factors in transportation to an extraordinary degree, they want to jump farther. T. A. Boyd, of General Motors, declares that the use of a 100-octane number gasoline instead of 70 in experimentation has given a 55 percent increase in miles per gallon at 20 miles per hour and more than 40 percent increase at higher speeds He points out that with an absolutely knock-free fuel one can get double the power or nearly double the mileage, but not both at once. Thus far the public has demanded the added power, but in the future it may favor greater economy and that would bring about smaller displacement engines than those in use today

There hasn't been much said about a motor fuel famine in late years for the very patent reason that research has made possible extraction of double the amount of gasoline from the crude oil and thus upset all the sound calculations of those who "viewed with alarm." Given fuels that will deliver the power and engines that will take it, focus attention on the merit of economy now that excellent performance is commonplace, and the net result would be more mexpensive motoring and a conservation of our petroleum

resources to postpone still further the day when motor fuel must be obtained from other sources

TRANSPARENT FILM

Ethylcellulose cast in brilliantly clear transparent film is coming into commercial prominence for modern packaging Under the trade name of Ethofoil, it is getting into large-scale production now that users have given it an extensive tryout

The properties which recommend this newer among the packaging materials are many. It is easily fabricated by light or deep drawing, much in the manner of metals, to make objects which have definite form while retaining their flexibility under long aging and high temperatures It can be produced in opaque. translucent, or transparent colors, it can be sealed with adhesives, stapled, or rivetted, and it is readily printed Ethofoil is not flammable but will burn with a slow flame. It is not affected by alkalis and is resistant to dilute acids. It transmits about 90 percent of visible light and a large proportion of ultra violet. The rays absorbed by window glass pass through the foil.

MORE NYLON

There's no gainsaying that nylon is a "natural" in the commercial world. With the announcement of the building of a new plant to raise the aggregate production to 16,000,000 pounds, Du Pont declares that this total is five times what was contemplated when the first plant was authorized in 1938. It is a snowball rolling up to huge proportions and it is a safe guess that world conditions are giving some of the shove

The United States takes about 78 percent of Japan's silk output. If we take last year's consumption of 50,000,000 pounds, we see that nylon will be ready to fill one third of silk requirements by 1942, and that will mean a beating of all records-even those made by the fast growth of Cellophane

ADMIRALTY METAL

Adding a small amount of antimony to the formula for the well-known admiralty metal gives a product which resists dezincification, sulfur corrosion, and inter-crystalline corrosion

Antimonial admiralty is particularly suited for heat exchangers, condenser and evaporator tubes, offering as it does resistance to corrosive water conditions as well as sulfur corrosive conditions. It is not without wartime significance now that the Navy has embarked on an expansion program

PHOSPHORESCENCE

You've read elsewhere in this issue that black light is going to town very largely from the boost given it by blackouts. Paralleling the rise of black light is the use of phosphorescent materials. Just around the corner is a phosphorescent wallpaper with no war implications It will be produced primarily for use in un-modernized hotels and boarding houses lacking bedside light switches. On switching off the light. the wall paper will glow for a sufficient time to enable the occupant to reach the bed without colliding with the rocker. Why not for nurseries of children afraid of the dark?

Four Centuries Late

Science and Society Begins to Recognize a Great Inventor, Engineer, and Scientist

ALBERT G. INGALLS

LONG in the 'twenties and 'thirties a good many Americans came to the realization that many of us had been too emotional and some of us even hysterical in some of our attitudes connected with World War I In our rage against our opponents many of us also condemned his literature, art, and music, not alone contemporary but past. For example, many would not play Beethoven's music because Beethoven was a German, though he had been dead 90 years and had nothing to do with the events that led up to that war Today, the great majority feel strongly about events political and military in the Old World, but it is pleasing to note that many have vowed they will not this time let their emotions run entirely away with their common sense, at least where things like art and music and science are concerned-things that belong to the whole world and to the ages.

When, some weeks ago, the New York Museum of Science and Industry obtained from Italy a collection of 275 working models of the inventions of the Renaissance Italian inventor, engineer, physicist, biologist, architect, and artist. Leonardo da Vinci, and put them on exhibition after they had similarly been on recent exhibition in Milan, nothing untoward happened Nobody planted a time bomb or even thumbed his nose Of course, the Italians, in willingly lending these models to the American institution, aimed without much doubt to enhance Italian prestige, but New Yorkers and others have flocked to see them. and still are flocking, probably because they simply wanted to see them All this shows that, since 1914-1918, the nation may have to an extent grown up.

Perhaps the reader has noted that, in referring to Leonardo above, the word "artist" was mentioned last, "inventor" first, reversing the customary sequence, Leonardo usually being thought of primarily as an artist. The motive is not to belittle art, which could not be done, but to help redress a bad balance of long standing If, a generation or more ago, one had asked the first 100 persons whom he encountered who Leonardo da Vinci was, it is believed that at least 90 might have replied simply. "A very great artist." Perhaps nine more might have been aware that Leonardo also dabbled in science, and maybe one out of the hundred fully aware of his greatness in realms scientific, would have said that Leonardo was so able in that realm that a time would come when his abilities in it would be recognized as the equal of those in art That time has begun to arrive

T is now approximately 450 years since this "tremendous universal genius" was doing his best life work, yet, even this long afterward. we know a very great deal about that work, also about the man himself. For example, we know from contemporary record what manner of man he was personally. The rather cantankerous disposition traditionally associated with great genius appears to have been no attribute of Leonardo's. His was a warm, sunny personality; he made many friends and kept them Physically, he was not a latin type; he is spoken of by contemporaries as golden haired.

We also have, in different large libraries, the actual originals, well preserved, of the 7000 pages of notes which Leonardo penned throughout his lifetime, in which he preserved his thoughts and conceptions in the realms of aeronautics, anatomy, architecture, astronomy, botany, engineering, geology, mathematics, medicine, optics, physics, and other corners of science; for he took the whole universe as his scope. All this and other available first-hand material affords us what might be called an "in-focus" picture of the man. rather than the somewhat fuzzy. blurred, out-of-focus picture we have of many great men who lived at even later periods-Shakespeare, for example, who lived a century later

No man of Leonardo's artistic and mechanical flair would be likely to write out 7000 pages of onces without also drawing some pictures, and thus it is that very many of these manuscripts are co-piously illustrated by clear, definitive sketches, not alone of things he had seen but of things he had sketches that the modern Italians made their 275 working models, many of them full-scale, of Leonardo's inventions, a few of which are shown on these bages.

Here one might be pardoned if the suspicion rose in his mind that the modern Italian model makers might perhaps have improved on them a bit while they were at itpeople often do this, unconsciously, when their heroes are involved In the present instance there was, however, no need to do so. It is true. Leonardo did not leave dimensioned blueprints, whether of a screw-threading machine design or that of an airplane, but his sketches are as clear and definite as an engineer's notebook sketch would be if made in 1940. Thus, in judging Leonardo's abilities, little 'courtesy allowance" need be made for the man's times. You get the impression, after studying his con-



Leonardo's design for an engine of war—a tank; also his script, written from right to left, a natural, logical direction for a left-handed writer

ceptions, that this was an artist who also felt as fully at home in the world of mechanics as our engineers do today. He quite obviously had a modern mind. In fact. it does not seem exaggerated to inquire whether, had the man been born in 1847, as Edison was, instead of 1452, he would not have equalled Edison as a conceiver of inventions, not to mention his far greater versatility in other fields than invention. He invented a helicopter, the double-hulled ship, a pile driver that looks remarkably modern, the power-driven band saw, a cannon actuated by steam.

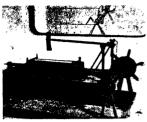
the rolling mill, pumps, lens grinding machines many other practical things

Beyond invention, Leonardo went far, for his time, into physics. He determined coefficients of friction, hinted at the principle of virtual work, studied out the principles of the composition of forces, and discovered the fallacy of perpetual motion. He also foreshadowed the principle of inertia which Galileo demonstrated a century later, and clearly defined what still later became Newton's Second Law of Matter (Gahleo and

Newton had no access to

Leonardo's writings and

A file shaper built from Leonardo's design (right). The file blank was to be clamped on the bed-plate moved by the lead-screw, while the cold-chisel on the tilli-hammer indented the teeth sortally in it





The first mass-production machine. Designed to point a number of needles simultaneously, against its horizontal, rotating abrasive wheel

This multiple cannon was not a "machine gun." as is sometimes

stated, yet it is based

Third, Leonardo himself lacked persistence and the businesslike, promotional type of enterprising makeup When contemporaries failed to grasp the significance of a given idea or invention, he did not try hard to convince them or to push it himself but simply returned to his sport of thinking up more ideas Moreover, he was inclined to lose some of his own eager interest in these ideas as soon as he had set them down on paper where they could not get away, probably this signified mainly that more ideas were pressing hard from behind

Can it not therefore well be that the price paid by the world for Leonardo's sunny, extraverted, sociable, but perhaps insufficiently pushful, personality was just about a solid century of delay in the arrival of our Age of Science on the world stage? If he had found a way to set his conceptions in actual movement it is altogether likely that we might be, today, where we now expect to be by 2040.



probably did not know that they

There are at least three reasons why Leonardo's great work did not have the expectable impress on scientific advance.

First, he did not publish it.

Second, in his time no organized, far-seeing industry existed to take up discoveries and inventions, as

on the mass-produced to principle of one. While top bank of barries was being fired, the bank in froat was cooling and the one behind was being leaded exists in ours. Not alone this but n that age people in general were to trepared to see the value of

exists in ours. Not alone this but in that age people in general were not prepared to see the value of science. Leonardo's contemporaries, for example, regarded his mechanical and similar activities merely as whims and notions, in which he was good-naturedly induiged by them because of his worth-while artistic activities.

SAVING SNOW

Plowed into Rows, It Prevents Later Drifting

You'n think there was enough snow in Canada without hoarding any—but the Department of Agriculture in Saskatchewan has announced the development of a new technique for snow conservation, reports Ethyl News In many parts of the country, farmers look to the melting snows of spring to do two work of early showers in wetting and softening the soil for plowing and planting. And since it is important to keep the snow right on the land where it will be needed

later, many experimental methods have been tried to prevent it from migrating

The latest and simplest — and prine latest and simplest in way of "tying down" the mantle of Jack Frost has been evolved by G. K. Matthews, superintendent of the Experimental School run by Saskatchewan in the town of Scott He drags a pair of especially constructed snowplows behind a tractor, lays each level field out in ridge-rows, and the problem is solved. The ridges anchor succeeding drifts

Canadian farmers and scientists alike have long tried to make an ally of the winter snows — getting alike have lother to went the soil instead of running off in streams that cut gashes through the fields and leave other spots so dry that wind erosion carries away the good topsoil Many a farmer has had to re-seed, not noce but twice, while his seeded and dultivated soil has blown across the road to bury another croe

WOOD BRIQUETTES

In the larger cities of the West-Los Angeles, San Francisco, Portland. Seattle, and Spokane-housewives can buy a new type of fireplace log in grocery or neighborhood stores, service stations, or from the ice man These neat, clean, and uniform cylindrical logs are pressed from sawdust and shavings from sawmills. The magazine American Forests reports the ever widening use of this product which provides a method of salvaging great piles of sawdust formerly wasted, or, at best, inefficiently burned in saw mill furnaces

One of the logs weighs eight pounds and is the equivalent in fuel value of an armload of ordinary wood or a bushel basket of waste shavings Three times the specific gravity of the original wood, these logs will not float on water

The process of making cylindrical fuel briquettes is not exactly new, as the machine was first developed some years ago. That machine has, however, been so improved that production on a large



One log equals an armful

scale is possible The sawdust holds together in briquette form solely through materials it originally contained — no string, wire, or sticky binders being used. The secret of its success is enormous pressure under which it is compressed—around 165,000 pounds

HINGED BUS

Threads Traffic, Carries More Passengers

THERE recently appeared on the streets of New York a unique vehicle in the form of a bus, longer than usual, and hinged just past its mid-section This is a new departure in surface transportation for cities of dense traffic The articulation of the two sections permits

a shorter turn than would be possible with a rigid bus of such length

The new coach is 47 feet in overall length, 96 inches in overall width and seats 58 passengers. which is the capacity of the ordinary street car Each of its two sections consists of the usual all-metal body construction riveted and gusseted to a steel underframing The two sections are joined at the center on a horizontal plane by means of a hinged section in the underframing, permitting front and rear sections to move up and down irrespective of each other A prestretched subberized covering provides flexibility at the joint Reverse steering on the front and rear axles gives the unit a smaller turning radius than an ordinary 40-passenger bus Hence, it may thread its way through heavy traffic with ease

This Super-Twin coach, made by the Twin Coach Company, is propelled by a Diesel engine of 175 horsepower, or it may be used as a trolley coach, obtaining the electricity from overhead high-voltage wires

"MAILED"

Time Capsule Sealed In

That 800-pound "letter to the future." the Time Capsule, which was buried in an open pipe before the Westinghouse exhibit building at the New York World's Fair, has now been finally "mailed" During the first season of the Fair, and until late in September of the second season, milhons of Fair visitors inspected the Time Capsule as it rested at the bottom of its open





Exterior and interior of the hinged bus that will reduce traffic difficulties

pipe container On September 23, 1940, it was finally sealed off by Dr Clark Wissler, archeologist of the American Museum of Natural History. Dr Wissler turned a crank which empticed from a large cauldron 500 pounds of a compound made of pitch and other chemicals —a special compound concocted for long keeping qualities.

The site of the Time Capsule will be marked by a monument It is firmly believed that no human eyes will again see it until archeological ages have passed

TWO-WAY TELEVISION

Demonstrated By Amateurs:

RECENTLY announced was the opening of a two-way television circuit, operated by radio amateurs, the distance between the two ends of the aerial line being approximately eight miles

Mr George Bailey, President of the American Radio Relay League, the nation-wide organization of radio amateurs, who flew from Boston to dedicate the new circuit. said "The American Radio Relay League is indeed proud to have a part in this latest indication of the thorough-going, practical-mindedness of the American radio amateur The conception of having two complete duplications of equipment, for a two-way demonstration and then airanging for simultaneous voice transmission is one of the things we would expect from Arthur Lynch, whose interest in



Mobile unit salvages ties from an abandoned railroad

known We are confident that this exhibition will be another link in the chain which is binding the amateur radio man closer and closer to the average radio listener

In commenting on the circuit, Mr Lynch said "The picture circuit is operating in the 112-118 megacycle amateur band—having one transmitter near the lower end, the other near the upper end 'This band, if expressed in the more commonly used terms, would be said to be on two and one half meter?

"The system which we are using can never be made to compare in clarity with commercial television. We use a system which gives us but 120 lines, while the commercial standards are in the vicinity of fixhundred lines. Then, too, the amount of power we use at our transmitters is only a very small fraction of the power used by the commercials. The cost of our equip-

ment is extremely low, in comparison A complete transmitter and receiver, of the type we are using on each end of our circuit, can be duplicated by any amateur for less than three hundred dollars. That includes all the tubes, but it does not take the voice channel into consideration.

"Our voice circuit operates on two frequencies in the 58-80 mega-cycle band, which is the equivalent of approximately five meters. The transmitter is equipped with several crystals, so that one of several voice channels may be selected at will, while the receiver is made with an automate noise-gate, which prevents any sound coming from the loudspeaker until the voice of the operator on the other end of the circuit is heard.

UPROOTER

Abandoned Railroad Beds Quickly Cleaned Up

A MACHINE which eliminates the tedious job of tearing up old closs tetes from abandoned railroad beds and hand-loading them on trucks and hand-loading them on truck of the ted on a Caterpillar tractor, this mobile loader pries up the old cross ties, swings them overhead, and slides them down a child in the rear so that they are loaded onto the body of a truck.

As shown in the accompanying illustration, swinging arms are mounted on an axle near the rear axle of the tractor Meeting in front of the machine, the two arms terminate in a two-prong, wedge-shaped fork which gouges under the old cross ties as the tractor is



Two-way amateur television set-up. Camera at left, receiver tube at right

moved forward. The prong holds several of these cross ties as the arm swings up on the framework mounted over the tractor and drops its load when almost directly over the tractor driver. The cross ties slide down a flat chute to the truck The truck is coupled to the tractor so that as the tractor moves the truck always follows.

This machine will dig up and load an average of 10 ties every 20 seconds, and with it a contractor is able to clear a mile of right-ofway per day

CONTOUR FINDER

ENGINEERS of the immediate future won't be forced to await the findings of ground survey crews, with the advent of the compact little "contour-finder" developed by the Abrams Aerial Survey Corporation the situation is changed.

The contour-finder, adapting a principle used by our grandparents -the stereontican-measures elevations of trees, hills, and buildings directly from a set of two aerial photographs. The drawing attachment accurately describes minute measurements, enabling engineers to run profile lines along rights of way, locate and draw contour lines around dam sites and drainage areas and obstructions in engineering work Tedious groundcrew survey work is thus done away with, engineers being able



Close-up of contour finder

to locate "control points" in a short space of days

The contour-finder was designed to complement the work of aerial survey crews mapping projects from high altitudes

The instrument is a compact one equipped with a drawing attachment for obtaining topographic information from vertical aerial photographs or from oblique photographs which have been accurately rectified. It consists of six parts. sterecscope, parallax measuring unit, drawing attachment, lighting unit, carrying case, and, optionally, an alignment mechanism.

In operating the device, a pair

of stereoscopic aerial photographs are placed under the instrument in such a way that two indicating dots cover the same point in both photographs. The dial gages are set at the mid-point of their range The photographs must be at right angles to the instrument and the dots in direct line with the line of flight or base line of the photographs They are then fastened securely to the



Contour finder in a

table. If the hand on the large dial is turned clockwise, the dot will appear to rise in the stereoscopic model and vice versa

By keeping the instrument in alignment with the pictures and moving the instrument with the floating dot always in apparent contact with the ground, a contour line can be traced on to another map of equal scale Higher or lower contour lines can be traced by raising or lowering the floating dot the desired vertical distance and then tracing out the constant elevation The heights of buildings, trees, and ground elevations can be measured ouickly.

FOLSOM MAN

His Actual Bones Never Found

Dr frank h. h. roberts, jr, Smithsonian Institution archeologist, last summer continued excavations for the fifth season at the oldest known inhabited site in North America-the Lindenmeier site in northeastern Colorado

This apparently was a summer hunting camp of the wraith-like makers of the peculiar type of spearhead known as the "Folsom point" which is found associated with the bones of extinct animals and in geologic strata dating from the closing centuries of the last great ice age.

Dr Roberts has obtained not only a large number of Folsom points, and bones of animals eaten by the hunters, but also many artifacts used in their domestic life. such as stone scrapers and knives. Thus far he has been unable to find any human bones.

There is still hope, Dr. Roberts believes, of finding a skull of one of these Americans of 15,000 years ago. It is possible that the dead were not buried but were left exposed on the surface to be devoured by the vultures. The bodies may have been burned or there may have been a special burial site which has not yet been uncovered.

DIESEL FILTER

Cheap, Easily Removable.

Protects Engine

An ingenious and highly effective filter has been developed by the Caterpillar Tractor Company for use in that company's Diesel engines So efficient has this comparatively simple innovation proved that laboratory tests show the new filters increase the life of Diesel inection pumps and injection valves by as much as 75 percent as compared with the usual edge-type metallic filters

The filter elements consist of a high quality, highly absorbent type of cotton yarn, wound on an inner metallic screen, which is wrapped with a filter paper Winding of the varn is done in a cellular pattern, with accurate spacings which are controlled in such a way as to provide increasing density toward the center Thus finer and finer particles are removed as the fuel approaches the center. In case an extremely fine dirt particle passes through the main elements, it is stopped by the filter paper.

The elements are easily remov-



Sectional view of Diesel filter

MISCELLANY-

able and are as inexpensive that they are simply thrown away when dirty, and quickly replaced. There is a gage, mounted on the engine, which shows the operator when replacement is necessary. Elements may be removed by simply removing the cover on the centrally located filter housing, and lifting them out.

FOR WINTER

Permanent Type

Anti-Freeze

TET," a new ethylene glycol anti-freeze, has been added to the product line of the automotive accessories division of The B. F. Goodrich Company.

The anti-freeze, the first ever offered under the Goodrich name, is of the permanent type, one filling furnishing radiator protection against freezing all winter

Odorless, the new compound will not evaporate or boil away; rust inhibitors prevent rusting. The new product will not damage car finish, mixes readily with other ethylene glycol anti-freezes, and can be tested with the standard hydrometers for such fluids.

MINIATURE ROOMS

Observer Sees Self

In Them

A MAGIC MIRROR that projects the observer into a series of miniature rooms is the feature of the new Alexander Smith Colorama Exhibit at Rockefeller Home Center at New York's Radio City. An involved optical system actually lets you see yourself, reduced to one eighth actual size, standing in the middle of a perfectly proportioned little living room less than eighteen inches long. Most remarkable of all is the fact that you see a side view of yourself, full length, exactly as others see you and as you have never before seen yourself except, perhaps, in motion pictures While you have been admiring

While you have been admiring yourself in miniature, a recorded voice has been patiently explaining the theory behind the Colorema Exhibit — that women should choose color schemes for their homes that flatter their particular type of beauty. The first room, the voice explains, is for a blonde. At this point a curtain descends over the aperture through which you have been looking and when

NATIONAL DEFENSE

Industry's No. 1 Job

by Westinghouse



- There's probably no single subject attracting more interest today than our National Defense program.
 Everyone wants to know the progress American Industry is making in producing huge stores of guns, planes, ships, tanks and munitions.
- Right now, several of our plants are working at top speed producing gun equipment and other machines which you would never find in the catolog of the thousands of products we manufacture. And very soon our production facilities will be substantially increased with the completion of fifteen new buildings in six different states.
- But the manufacture of these emergency products is only a part of the equipment our company is supplying. The electrical products that we build are a vital necessity in the National Defense program. Our long experience in designing and building practically every known electrical product is now being utilized to the limit by both government and industry alike.
- . Our plants are working night

- and day to fill orders for millions of dollars worth of electrical equipment-equipment such as turbines for marine service; motors and control equipment for cargo ships; motors and generators for submarine tenders; generators and X-Ray equipment for the Army: radio equipment for all the Services; Seadrome contact lights for naval air bases: distribution and instrument transformers for shipbuilding yards. Then there are ignitron rectifiers, multiple arc welders, meters, lighting equipment, Micarta and scores of other products, all wanted in a hurry by other manufacturers who are working on important defense orders
- In addition to filling these orders, we have still others from the more than 100,000 dealers and wholesalers who sell our home electrical products and Mazda Lamps.
- All of these are orders that must be filled. Neither we, nor any of our industry partners, can afford to permit any bottleneck or business stalemate occur because of lack of the equipment that we supply. We must constantly bear in mind, too, that even greater demands will be made on us tomorrow.
- One of the most important things our company has done to assure efficient fulfillment of all these demands is the creation of an Emergency Products Division. Through the work of this division we are maintaining full concentration on defense problems, but in ways that least affect the important production of our regular electrical lines.
- National Defense is most certainly a tall order. And we at Westinghouse, like all American Industry, consider it the most important order in our history.

it goes up again you find your image in another room identical to the first except for the color scheme This goes on until you have seen yourself in five little rooms

The optical system that reduces you to one eighth your size and projects you into the miniature rooms is not quite as complicated as might appear at first blush A full length mirror well to one side of where you stand picks up your image, and lenses focus it on a "transparent mirror" behind which is one of the miniature rooms. The "transparent mirror" can function either as a mirror or as a piece of clear glass depending on whether the light in front of it is greater than that behind or vice-versa As you stand looking into the aperture, a brilliant light illuminates your figure and thus when your reflection in the full length mirror is focused on the "transparent mirror." the part of the latter that receives the image acts as a mirror. whereas the rest, because the lighting in the little room is less intense, is perfectly transparent and allows you to see through the glass to the miniature room behind The illusion that you are actually standing in the room is complete

BRIGHTEST FLASHLIGHT

Small Light Throws

W hat is believed to be the brightest portable battery light in the world, smaller than a man's head but so powerful that it is possible to read a newspaper by its light half a mile away, has been developed by Mr Jackson Burgess of the Burgess Laboratorjes.

The new portable lantern, with 180,000 maximum beam candle-power, is 180 times as powerful as



180,000 beam candlepower



For the tropics: 17,500 tons, all staterooms air-conditioned

the best two-cell flashlight on the market

The spot of light cast by the lamtern at aim's length is 45,000 footcandles, which, by mathematical calculation, is four and one half times as bright as sunlight on a spot of the same size Theoretically, at 100 feet it has 180 foot-candles which is equal to the average office illumination. The light output of the new lantern far exceeds that of an automobile spotlight or two automobile headilights.

The new light may be used by fire and police departments as emergency standby lights, and as meregency standby light for airplanes. It may also be carried in planes to be used in emergencies as protection insurance, similar to the way in which modern air transports carry battery-operated radio transcription.

COOL SHIPS

First to Air-Condition All Staterooms

SOMETHING new in hand-made weather for tropical waters will be introduced in 1941 when Moore-McCormack's American Republics Line supplements its regular services to the east coast of South America with four new combination passenger and freight liners

The new liners will go in for air conditioning in a big way They'll feature it not only in public rooms —as the newer ships are doing but for the first time will also install it in each and every stateroom

Pioneer vessels to be thus equipped, the new liners will accommodate 196 passengers and are being built because of the greatly increased interest of Americans in touring South America Of 17,500

tons displacement, the ships will be 492 feet overall and will have a molded beam of 69 feet six inches. Their two Diesel engines will develop 9000 horsepower and give them a speed of 17½ knots

AUTOMATIC COFFEE

To the automatic toaster which has graced many breakfast tables for years, may now be added an equally automatic coffee maker Embodying all the features of existing glass coffee makers—clean glass bowls, fascinating operation,



Better coffee-automatically

and ease in making good coffee the new device eliminates certain disadvantages which have been experienced by coffee makers

The Almo magnet, versatile General Electric product, is the key to this new appliance A small cylindrically-shaped Almo magnet, coupled by suitable levers to a pair of contacts, is held in its upper position by a small stainless steel keeper located on the lower end of the lower bowl tube. As the last of the water is forced into the upper bowl, excessive turbulence in the tube breaks the circuit, allowing the magnet to drop and turning off the unit As the brew returns to the lower bowl, a thermostat turns on

a separate warming element which maintains the coffee at a temperature of approximately 185 degrees for an indefinite period

INSECTS

Follow Armies of The World

Ir HISTORY is allowed to repeat, say officials of the Bureau of Entomology and Plant Quarantine, the present war may add to the insect pests that have invaded new territory because of armed conflict among men The Hessian fly, which each year destroys wheat with an estimated value of \$13,000. 000, came here with the German troops hired by George III to suppress the rebellion Turning the tables, the Colorado potato beetle crossed the ocean in 1917 with the American army and settled in France, subsequently spreading to Germany where it is a serious threat to an important food crop. During World War I, Australian wheat replaced American wheat which had been shipped to Europe Some believe these importations introduced flag smut in America

CHRISTMAS TREES

Fireproofed by

Simple Treatment

MANY people preserve their Christmas trees for long periods by inserting the butt in a container of water. The live tree absorbs water, sending it through all branches and leaves so that the decorated tree may stand for many days.

This ability of the tree to send water throughout its structure may be made use of to fireproof the tree According to American Forests magazine, Dr Martin Leatherman, associate chemist in the United States Department of Agriculture. has found that fairly concentrated solutions of ammonium sulfate or calcium chloride will usually do this job effectively. Dr. Leatherman says that the trees to be so treated should be as fresh as possible. Before treatment, an earthen crock. glass jar, or a galvanized pail should be available. Then the base of the tree should be cut on a long diagonal slant or in the form of a narrow V. The chemical preferred is ammonium sulfate, because it is cheap, effective, and easily obtained. The quantity to use should



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be one fourth the weight of the tree It is dissolved in the ratio of one and one half pints of water for each pound of chemical. The tree is then set in the solution and away from direct sunlight until most of the solution is absorbed. Dr. Leatherman obtained best results when the surrounding temperature ranged between 55 and 65 degrees, Fahrenheit. The solution absorbed more readily at this temperature and the follage retained its green color longer than when treated in a warm room.

Treatment of trees in this manner does not mean that all fire hazard has been eliminated but only that the tree itself will not readily catch fire. Other decorations used with it should, therefore, be of fireproof quality

MAGNETIC ALLOY

Holds More Permanent Magnetism Than Any Other

A NEW magnetic alloy of remarkable qualities, "Vicalloy," was announced recently to the American Physical Society by E A. Nesbitt and G. A. Kelsall of Bell Telephone Laboratories of New York, Composed of cobalt, vanadium, and iron, the alloy can be made to hold more permanent magnetism than any other commercial material In addition, it can be drawn and rolled-a property of advantage in many applications, and not possessed by other permanent magnet materials of importance in the art For example, it has been rolled into tape 1/500 of an inch thick and 1/20 of an inch wide Several thousand feet of this tape were used for sound-recording at the New York World's Fair, while shorter lengths are running constantly as endless loops in the Bell Telephone weather-announcing systems



A tiny loop of Vicalley sup-

Taking its name from the initial letters of its three components, the new material is composed of 6 to 16 percent vanadium, 30 to 52 percent iron, and 36 to 62 percent cobalt. From the molten state, it is cast into an ingot, which is hot-swaged to 1/4 of an inch diameter. It is then drawn into wire or rolled into tape, as desired. When in final form, it is heat-treated to develop its magnetic qualities. It is permissible to use a heat treatment that will not be harmful to most high-permeability materials. Thus it is possible to weld such meres to the magnet and heat-treat them both together.

GIANT TESTER

Materials Testing Machine Very Accurate

A 100-TON materials testing machine, so powerful that it can bend two parallel, 12-inch, steel I-beams, yet so accurately controlled that it can crack a nut without



100-ton testing machine. Note the man on the transverse table

crushing the kernel, has been built by the Riehle Testing Machine Division, American Machine and Metals, Inc. Riehle directing designers have released the following specifications: 34 feet high, 21 feet wide and 24½ feet from front to back The transverse table, one of the largest ever built, is 8 feet wide.

Not only is the machine one of the largest ever built in the United States, as well as the world; it is also among the most accurate. Though it can exert a maximum of 700,000 pounds pressure, the mechanism has recorded a maximum error of 0.00 percent, making it one of the most sensitive machines of this type ever built. German technicians refuse to build machines more accurate than 1 percent—sixteen times greater error than this machine.

In routine tests the machine snapped 12 by 12-inch wooden timbers with a pressure of 500,000 pounds. Steel tubes three inches in diameter were crushed at 600,000 pounds pressure.

When finally set up, this machine will be used for routine testing and as a primary standard for the verification of calibrating instruments. It required eight months to build; two months were spent in design alone.

WEATHER NERVES

Bosis Found for Effect

Ridiculed as "Just Imagination"

Ir youn temper and nerves get more edgy when a storm is approaching, it is probably because the water balance in tissues of your body actually is disturbed due to falling barometric pressure outside. Advancing this likelihood, Dr C A. Mills, of the University of Cincinnat College of Medicine, advocates that scientists should closely investigate body changes thus involved when stormy weather brews.

Suicides are more likely to occur when a storm center approaches, Dr Mills stated Domestic troubles flare up most readily. It is harder to think clearly. Even animals become more inclined to fight, and less reliable, "With declining outside pressure." he explained, "tissues take up water and swell, much as does a sponge, while with rising pressure they give up water and shrink." In girth measurements of his own leg just below the knee, he observed changes of half an inch or more with major weather changes, and some people changed several pounds in weight.

OUTWITTING GRAVITY

Of Two Identical Balls.

One is Lary

I wo steel balls of identical weight and size recently disproved one of the rules of gravitation by relling

-MISCELLANY-



Same weight, differing "gravity"

at different speeds down an incline Dr Phillips Thomas, Westinghouse research engineer, performed the experiment to demonstrate how the friction of tiny particles of loosely packed powdered tungsten inside one of the balls made it lazy by absorbing part of its energy

Westinghouse engineers, Dr Thomas explained, have used this same principle of energy absorption to prevent electrical relay contacts from bouncing apart when they are closed, thus eliminating sparking and reducing wear on electrical control equipment

MILDEW PROOFING

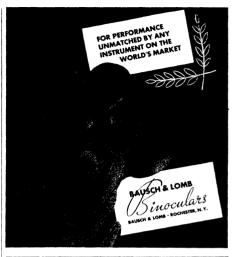
Simple Home Treatment

For Fabrics

MILDEW can be prevented This is the conclusion reached by Margert Furry, Helen Robinson, and Harry Humfeld of the U S Department of Agriculture after studying 135 recommended treatments. Of these, 35 were effective, about 10 practical for home and farm use Tests are continuing in the home economics laboratories

Use of such finishes will save money, these investigators point out. Middew proofing will ship preserve tents, tarpaulins, saids, sandbags, and other pieces of canvas equipment often stored in moist or poorly ventilated places. In the home, shower curtains, awnings, and canvas on porch furniture may need treatment. Unrested cotton fabrics are likely to mildew—then develop discolored and musty-smelling spots. They may be attacked so severely that they rot and fall to oiscess.

Directions for treating an average-size shower curtain illustrate



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Addres

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one of the simplest methods and call only for a good laundry soap and crystals of cadmium chloride. available at drug stores. Have the cloth thoroughly clean Heat it in a solution of one to two ounces of soap to the gallon of water About one and one half gallons will cover a shower curtain Heat 20 minutes. remove the cloth, and squeeze out excess soap. Put the wet cloth into a second solution of cadmium chloride crystals, three ounces to the gallon of water about one and one half gallons required. Heat for about 30 minutes, wring out, and dry without rinsing Hang to dry on a twine line (a metal line may stain the fabric) This treatment does not affect the color of the curtain, which will be resistant to mildew until laundered again

PLAINS PREHISTORY

Five Stages of 10.000 Years

LONG before covered wagons of white settlers jogged toward the West, at least two great migrations of red men, their wives, and children plodded westward on foot to possess the Great Plains

New chapters of the central Great Plains prehistory, reconstructed by Dr Waldo R Wedel of the Smithsonian Institution from archeologists' burrowing into Indian ruins and searching Plains terrain, can be briefed as follows

1 About 10,000 years ago, the first men and women peopled the Great Plains, roving eastward from the Rockies Nomad bison hunters, they were some of the early Americans identified by the distinctive stone dart points known today as Folsom and Yuma weapons

- 2 Then came a blank chapter, enormously long, when the Plains were apparently abandoned by man
- 3 The first easterners re-discovered the Plains They moved cautiously, were not numerous. and were peaceful Indian settlers, not wandering hinters
- 4 Later a second migration of different, more progressive Indians arrived Also peaceable, these easterners brought the gift of corn, made better pottery They were mound building tribes Mysterlously, these best settlers abandoned their homes and vanished, before white men saw the Plains.

5 The Spanish conqueror, Cor-

onado, seeking non-existent golden cities, marched from Mexico as far as Kansas in 1541, and was the first white discoverer to view Plains tribes. Nomad hunters were on the rise, harrying Indian settlers Provided in time with white men's firearms and horses, the Indian hunter became ruler of the Plains. ending Indian dominance with a brief bison-hunting era-as bison hunters had begun the conquest -Science Service

LUMINOUS BRICKS

LASS bricks have been used more and more widely, because of several advantageous features, during recent years Soon it should be possible to erect walls of glass bricks which admit daylight during the day and are luminous at night This glowing light from the bricks at night would be so well distributed that there would be no bright snots

Electricity is passed through these bricks, which are coated inside with fluorescent material similar to that used in the widelyknown fluorescent tubes If ultraviolet light is needed in a room, the bricks can be made of materials which transmit these rays, while a small amount of mercury inside each brick would be used as the source of the ultra-violet

Rights to this invention have been assigned to the General Electric Company

NEW CORNET

Design Changes

Improve Playing, Tone

 $\mathbf{S}_{ ext{LANTED}}$ pistons and a new tone spiral are features of a cornet and trumpet recently developed by a leading American manufacturer Tests indicate unusual playing ease, substantial power, and added high tones for the new designs.

While the conventional horn is built in an oval spiral, with the mouthpiece at the level of the bell the new models provide an everrising air flow. The mouthpiece, at which the tone column originates, is the lowest point of the tubing when held in playing position This



". . . ever-rising air flow"



Piston valves on an angle

feature, the makers believe, may account in part for the ease and flexibility of tone production

By installing the piston valves on an angle, a more natural and relaxed position of the hand and fore-arm is permitted, which in turn leads to improved muscular control and facility

DANGER UNIT

Degree of Danger

In Driving Cars

To MEASURE the hazard involved in driving at various speeds, the Travelers Insurance Company has developed the "danger unit" which is defined in stopping distance. roll over, vertical fall, and turning radius, reports the Stone & Webster Bulletin

Under average conditions the distance an automobile moves after its driver has decided to make an immediate stop varies as the square of its speed. A "danger unit" equals 35 to 40 feet of stopping distance A car traveling at 25 miles per hour can be stopped in this distance, while in stopping from 50 miles per hour it will travel between 140 and 160 feet, the equivalent of four "danger units" Nearly one full "danger unit" is added when the speed of a car is increased from 45 miles per hour to 50

In case of too sharp a turn, a car will sometimes roll over once for each "danger unit" it carries Thus it may roll over once at 25 miles per hour twice at 35 and perhaps nine times at 75 It is well to remember that only in the luckiest accident can the driver cling to the inside of the rolling car as it does its three turns at 45.

Striking a solid object at 25 will do a car about the same damage as if it had been driven off a twostory building Encountering a stone wall at 50 will be just as serious as if it dropped from four times two stories, or eight stories When Captain George Eyston was doing 300 miles per hour and more on the dry salt beds of Utah, his big engine was packing energy into his car with such industry that it was adding one "danger unit" for each mile of increased speed Had he hit a solid stone wall he and his machine would have been smashed as completely as if he had driven off a 3000 foot ledge into Grand Canyon

Each added "danger unit" causes the car to require a longer turning radius. Thus a car can make only oné fourth as sharp a turn at 50 as at 25, one ninth as sharp a turn at 75 as at 25

RUBBER GLUE

Non-Flammable, No Odor. Keeps Well

A NEW cement, Texglue, with a latex or rubber base, and compounded to afford exceptional adhesive properties and resistance to aging has been announced by The B F Goodrich Company It contains no flammable solvents

The new product is of special interest to upholsterers, awning manufacturers, and leather fabricators as well as to anyone having any requirement of adhesion of fabrics, paper, leather, or other porous materials Texplue also will attach fabrics, paper and other materrals to non-porous surfaces, and can be easily cleaned from these surfaces when its mission is accommission

There are many non-industrial uses for Texglue as an office paste. eastly removed, leaving clean paper surfaces, for sealing packages, applying labels, posting bulletins. It also can be applied as an anti-skid coating for rug bases, used to repair clothing and household furnishings, and to stop runs in hosiery

Non-flammable, with no objectionable odor, the cement can be stored in normal atmospheric temperatures, with avoidance of freezing temperatures or heat above 90 degrees

HI-JACKING THE ANT

Formers Get Ants'

Collection of Grass Seed

By hi-jacking the harvest of buffalo-grass seed which red ants accumulate-probably as a source of winter feed-southern farmers and ranchers can sometimes gather a supply of seed at slight cost. One farmer in Bell County (Texas) got about 200 pounds of clean seed in



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two days from ant hills in a pasture of native buffalo grass, says W. J. Neumann in charge of a soil conservation project of the U S Department of Agriculture, near Temple, Texas

Soil Conservation Service men. who noticed that red ants collect buffalo-grass seeds and pile them around ant hills, were able to tell the farmer how to get seed for planting The seed material was swept together with a stiff push broom and then run through a commercial cleaner to separate the seed from soil, trash, and weed seeds

STEEL EATERS

Bacteria Thrive on Iron and Steel

THE discovery that certain bacteria hoing underground thrive on iron and steel pipes, causing annual rust and corrosion damages running into the millions, was announced at the convention of the American Gas Association by Raymond F Hadley of Philadelphia, electrical engineer of the Susquehanna Pipe Line Co

Known as anærobic bacteria because they live in an atmosphere devoid of oxygen, it has been found that they can survive for long periods of time when brought to the surface When magnified 850 times under the microscope, they appear in the shapes of coil spirals or curved rods They are particularly hardy Cultures have been grown from soil water taken from under ice They also have withstood temperatures as high as 176 degrees

Once the bacteria have taken hold, the maximum life of a pipe is approximately seven to ten years The rate of corrosion under their attack is nearly three times that of other types, with the exception of carbon contact, stray electric currents and concentrated acid

There are 450,000 miles of gas, oil, and water distribution systems in the United States, all of them susceptible to attack by the bacteria

BUGS IN PLASTICS

Transparent Sheets for New Mounting Method

For schools, laboratories, and camps, a new method for mounting biological specimens has recently been worked out, utilizing Monsanto cellulose acetate. The mounts consist of two flat sheets with a hollow in the center of each. The specimen-butterfly, beetle, or other insect-is laid flat on one sheet with the body of the insect resting in the hollow Another sheet of the same size is placed over this Wings and limbs are between the sheets while the body rests in its cavity The two sheets are then



Oval center holds the body

cemented together. The mount is now complete in a permanent, fully visible, and insect-proof arrangement

The mounts, known as the Schwarz Transparent Mounts, are being manufactured by the Frank Schwarz Studio, of St Louis, and distributed through the Central Scientific Company

APPLE IUICE

"Flash" Pasteurization Product Resembles Fresh Juice

HE "flash" pasteurization for preserving apple juice, developed by specialists at the State Experiment Station at Geneva, New York, provides a reliable and relatively simple method for use on the farm which will insure a product that is being well received by the public because of its close resemblance to

freshly pressed apple juice The essential features of the method include straining the juice carefully, heating it quickly to 170 degrees, Fahrenheit, and then putting the hot juice into bottles or cans without further treatment After standing for a few moments. the containers are quickly cooled The resulting product possesses much of the flavor and aroma of the freshly pressed juice and will keep indefinitely

"Until recently the only juice which could be prepared and preserved in the kitchen was tomato juice," say the Station specialists Now, however, "apple, cherry, grape, and many other fruit juices are used daily in the home. Improved quality of preserved fruit nuces has been made possible by development of methods of processing within the last few years. These improved methods include continuous flash pasteurization with little or no loss of flavor, methods to exclude air from juices which formerly caused changes of flavor and deposit of undue amounts of sediment, and perfection of containers, both bottles and cans."

ART IN PLASTICS

Cold-Molding Material Makes Plagues

PLASTICS have found then way into art many times, yet usually there is some difficulty in handling them A new cold-molding plastic, made by the Monsanto Chemical Company, Plastics Division, obviates one of the most troublesome factors



Delicate modeling in plastic

in plastics molding—the use of heat Consequently, attractive, decorative plaques are now being cast from this material by W. L. Stensgard & Associates An accompanying illustration indicates the delinate modeling that is possible when using the material for casting in this manner.

The cold-molding plastic is originally in the form of a liquid When this fluid is mixed with another and poured into molds, it hardens without heat into a durable, rigid plastic of warm color and pleasant texture.

SAWDUST STOVE

On the West Coast there is being produced a new sawdust burner which reduces the sawdust to a gas which in turn is burned in the combustion chamber to give efficient heating. The sawdust is loaded into a hopper beside the stove. Heated

by the flame above, the sawdust is converted into gas and a small amount of exhausted ash The sawdust smoulders on the grate, does not backfire, forms no crossote, and burns continuously so long as the hopper is kept filled Users have reported a fuel cost of 75 cents to \$150 per month

GEOLOGIC MUD

New Technique Verifies

Geologists' Claims

Mud deposits, 500 feet thick, on the deeper parts of the ocean floor, represent the accumulation of all geologic time, some 2,000,000,000 years Deep ocean deposits grow in thickness at the rate of two or three centimeters in from 5000 to 10,000 years A layer of sediment ten feet thick may represent a time interval of from 100,000 to 200,-000 years

Dr Joseph A Cushman, director of the Cushman Research Laboratory at Sharon, Massachusetts, and a noted authority in marine geology, recently emphasized these facts as being of extreme importance in interpreting the geologic history of ocean muds, because wide ranges in geologic time are thus preserved in core samples of only a few feet in learth.

Vertical core samples 10 to 12 feet long have recently been collected from the deeper parts of the North Atlantic by the Piggot "gun," invented by Dr C S Piggot, of the Geophysical Laboratory of the Carnegie Institute of Washington Core samples obtained along the line of the Atlantic cable, from Newfoundland to Ireland. contained abundant fossil remains of tiny life forms, diatoms, and the snail-like foraminifera, which reflect climatic conditions prevalent at the time of deposition Warm water foraminifera, such as live now in the Gulf Stream, alternate with types characteristic of the Arctic These alternations of cold and warm types of foraminifera probably correspond to the known advances and retreats of the great ice sheet that once covered half of the North American continent

Even mud samples taken from the deepest portion of the Caribbean reflect the thickness of the great ice cap once lying far to the north. Cores from the Caribbean were described as showing definite cones of concentration of warm water foraminifera separated by zones in which they were absent



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All Contrasts In One Paper

Diances in the color of the printing light when teamed with a suitably coated printing paper will afford a variety of tone contrasts in the one paper. With this as a basis, the Defendee people went to work to produce the paper and the method by which "complete contrast control" could be had in one grade of paper. The result is Vanigam (varied gamma), and the texts we have given indicate the method to be both suitable paper.

We made three separate tests on different occasions under the tollowing conditions. Darkroom illumination was by red safe-light. Varigam being sensitive to the ordinary printone safebooks but not to red. A negative of rather stronger than normal density was used in two of the tests and a normal strength negative in the Development was in D-72 est breeze diluted 1 to 2 for two of the tests and in the Detender recommended 55-D in the third. In the first two tests the both was made up as usual and the whole batch run through in the one bath. In the last test, with the 55-D, a separate, new bath was made up for each print to assure like developer conditions for each of the prints. The temperature for each bath was held at 70 degrees and development was for 112 minutes. The enlarger light source was the popular "211

With each package of Varigam paper, Defender supplies a yellow and a blue gelatin filter, together with a cardboard filter holder between which the filters are sandwiched by binding the edges with lantern-side binding tape. These filters are held under the enlarger lens of attached to the lens

barrel with tape. By varying the proportionate length of time during which each of the filters is held under the lens, thus coloring the light yellow on blue, as the case may be, different grades of contrasts are obtained on the one paper, blue light providing contrast—yellow light softness.

A test strip is made in the usual way For this purpose the manufacturers recommend making a test with all blue light, but we have found it easier to judge proper printing time by cutting the exposure time in two, exposing half the time through the blue, half the time through the vellow filter. The exposure learned through this fast will be the same for all other combinations of the two filters. In our test, the total exposure time was 14 seconds, and this remained the same for all the prints made from the same negative, the timing being distributed as follows: 2 seconds for the blue, 12 seconds for the yellow, 4 seconds for the blue, 10 seconds for the yellow, and so on, plus 14-second exposures made entirely with vellow light and entirely with blue light

The resulting print contrasts gave a range from very solt gradation to very hard, with prints of distinctly different contrasts in between the two extremes, from the same negative

A more convenient method of altering the color of the light is the use of
the Duraline Print-Control Filter Set
the Duraline Print-Control Filter Set
the Duraline Print-Control Filter Set
by Harrison, 6 Halfrison, 07 Hollywood, California These are available in
either the Standard Set, which
contains ten filters with varying mixtures of the yellow and blue filters,
of the Special Set, containing five
filters. The first provides ten degrees
of contact from YB1 (very soft) to
contact from YB1 (very soft) to





YBI

SCIENTIFIC AMERICAN · DECEMBER 1940

YB10 (extra hard), while the smaller set includes YB1, YB3, YB5, YB8, and YB10 The latter is quite satisfactory and if an additional filter may be required later on, it can be purchased separately With the set comes a dual snap holder, fitting a designated lens The filters are easily diameter snapped in and out. In addition, a lock ring may be had for permanent attachment to the lens barrel

The other two tests were made with the Duraline filter set, and provided an amazing range of contrasts in the same printing time for each of the prints YB5 was used for making the test strip, after which all prints were made for the same time, the filters being snapped in and out successively in easy, routine fashion except that in the 55-D tests, a new bath was made up for each print. This was for test purposes only, however, and is not necessary in normal working practice. An indication of the range may be seen in the reproductions made, respectively, through the YBI, YB5, YB8, and YB10 Duraline filters If the engravings do justice to the originals, you will be able to judge of the results for yourself

We believe that in actual use, the average worker will eventually settle down to two or three, perhaps four filters or filter combinations (Incidentally, the Duraline filters must be used separately and not in combination with each other, since the varying combinations of blue and yellow are already incorporated in each of the filters) The other filters will be used for those special negatives requiring other than routine treatment

In actual use, the Varigam worker will forget all about the usual contrast designations and refer to them as YB contrasts instead In the beginning, he will make up a panel of prints from a negative of normal contrast and hind them into a folder or mount them. over his printing table. This panel he will use as a guide in selecting the proper filter to use with a particular negative If the negative is softer or harder than normal, he will make the proper allowance, just as he would with different grades of paper The advantage with Varigam, however, will be that a change in the filter rather than the paper is all that will be called for After the worker has become accustomed to processing Vangam, he will refer to contrasts not as normal or medium or hard, but as YB5, YB8, and so on And this, we feel, is a very definite and helpful advance in the art of printing

Movie-Making With a Purpose

F you make a plan and try to stick to it, your movie-making activities will be the more valuable because they will build up to a definite goal rather than a miscellany of discon-nected short lengths. Moviemakei George Post, of New York City, who, incidentally, has been shooting Kodachrome exclusively ever since it appeared on the market, has a scheme that, to our mind, is worth imitating George has a rather wide range of interests, finding pleasure in shooting either flower closeups or the Cuban dancers at the World's Fair, scenic effects in the country or subjects in the intimacy of his own home. But one thing he abhors, and that is mixing his interests on any one reel. The plan he follows is this. Whenever he comes across a subject he likes, he shoots as much film as he thinks necessary and spools it onto an empty 400-foot reel. If his next subject is in another category, he spools it onto still another reel even though the first has only 50 feet on it. When he has occasion to shoot another aspect of the first subject, he adds this footage onto that reel. And thus he proceeds until the 400-foot reel of the one subject has been filled. In this way he edits as he goes along, cutting off what he does not want before splicing it. He tries when possible to get at





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[For Complete Contest Rules, See Page 266, November 1940 Scientific American]

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'N this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPE-CIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners These special awards will be given in addition to the regular prizes that the pictures win

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on Portraits will be grouped in this division Division 2. Landscapes, including all scenic views, seascapes, and so on

Division 3. Action, including all types of photographs in which action is the predominating feature

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Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price \$24.) 2nd. One No. 650 Weston Exposure Meter (List price \$19.95.) 3rd. One No. 850 Weston Exposure Meter (List price \$15.50.)

THE JUDGES

McClelland Barclay, artist Ivan Dmitri, artist and photographer T J Maloney, editor of U S. Camera Robert Yarnall Richie, photographer

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least 400 feet of any one subject he tackles, though the period between the first shooting and the last may be S Vest.

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Local Boy Makes Good

BORROWED camera, much enthusiasm and first-hand knowledge of the terpsichorean art, started 27-year-old Constantine, New York City dancer (he prefers to use this name just as he has done in his dance work), off in photography a little less than a year ago Unaccustomed as he was to the vagaries of the camera shutter and finder, he cut off heads, legs, et cetera, and wept afterwards at what he called his stupidity, although, as everybody knows, the name for that is inexperience

In time, however, he was able to get the dancing figures intact on the film and to make creditable prints As he gained proficiency, confidence came along too, until the day came when he felt he was good enough to deserve a camera of his own. To make a long story short, he now has professional equipment, including a



7th Symphony of Beethoven



From the prompter's box

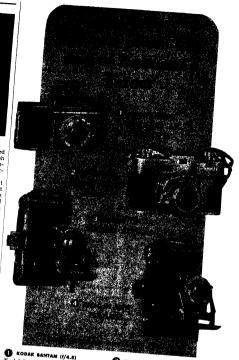
miniature camera and the Speed Graphic, using the latter for flash work almost exclusively, and has assumed the mantle of dance photog-

The best part of our story is that Constantine did so well that the Ballet Russe dancers permitted him to come backstage for posed flash shots and work from the prompter's box with a work from the prompter's box with a ministure camera during the per-formance. He used the Contax in the latter vantage point and was able to get very good stills of action at 1/50 second with the f/1.2 Sonnar lens wide open. The pictures he made on these occasions turned out so successfully that the Kamin Gallery in New York City staged a one-man public exhibition of a selection of his best pictures Specialization in the one field he knew particularly well is undoubtedly the reason for Constantine's sudden rise to fame

Printing-In Clouds

The recently had occasion to print clouds into a bald sky, yet retain a sharp outline of a projecting figure in the foreground The job was accomplished in a rather simple manner Instead of the usual procedure of making an exact outline of the foreground and keeping it shaded with painstaking exactness while the clouds were being printed in, a rough outline was made for the foreground. The sky being dense, a straight projection of the negative provided the foreground subject image, with nothing but white paper where the clouds

This print was then placed in the developer. As soon as the image had come up very lightly, the print was removed from the developer bath and placed in the stop bath. It was then swabbed with cotton and placed on the easel again, with a biotter underneath to protect the easel. The cloud negative, which was previously striptested, was then projected while the foreground was shaded roughly with the rough outline mentioned. The exposure complete, the paper was re-



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placed in the developer and left there for the full time, after which it was placed in the stop bath as usual, fixed and washed The result showed sharp image outlines with clouds printed into the bald sky, the whole giving the effect of having been made from a single negative-no break was to be seen anywhere

Light Makes the Picture

WITH great economy of light reflections, with only the salient points high-lighted and the rest in semi or complete darkness, the accompanying illustration of the outdoor musician was made at night outdoors by the light of a few small ceiling



hulbs. Shooting from street level up. to the hand-stand, the exposure was 1/10 second at the full opening of the Tessar f/3 5 The light outlines the instrument in just the right places, providing just enough high-lighting for the purpose and no more Vibration of the instrument is apparent in the outline high-lights, thus affording an impression of a tuba (or whaddya call it) in full blast

Touring Exhibit Proposed

EELING that some method is in order for giving impetus and assistance to local photographic contests, Albert Greenfield made the following proposal in a recent issue of the New York World-Telegram " formulate plans for a traveling exhibit of photographic equipment, combined with local photographic contests under the auspices of a grand council comprised of representatives of every organized trade association in the photographic field "

"Why forget about the amateur photographers?" asks Mr Greenfield They are the ones to see and inform about new equipment, and in their interest lies the market of the photographic industry

"The traveling exhibit that I have in mind could start in New York City, go to Philadelphia, then to Boston and



f

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to every important city in the East This exhibit would then cover every important city in the South and Midwest, and eventually reach the West Coast After a complete tour of the country has been made, a new revised show would be organized again to tour the country"

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FILMO FADER Designed for professional effects with amateur movie cameras Adjustable indicator visible in camera viewfinder shows when fades and wipes are completed. Fader said to be automatic: fits all makes of and 16mm cameras and makes fade-ins, fade-outs, wipe-ons, wipeoffs, and, where camera is equipped to rewind film, transitional lap-dissolves Fader can be mounted at any angle to permit wipes to appear or disappear from any direction Fades made with rotating disk graduated from opaque black to clear sector, and back again to opaqueness

THE ROUND TABLE Questions Answered for the American Photographer

Q Can you supply a formula for writing over the numbers on glass graduates to make them more visible?

A An effective "ink" for writing on glass so that no matter how much water is passed over it, it will not be washed off, is the following:

A drams

Shellac, unbleached 4 drams
Alcohol (85%) 4 ounces
Borax 7 drams
Water 6 ounces
Then add 12 grains aniline (adding
any desired color).

Q. I don't understand why it should be necessary to make the labels referred to in your item on "Labels on Bottles," issue of August, 1948, out of photographic paper instead of ordinary paper of corresponding quality—for instance, high-grade bond writing paper.—H. Y.

A. Fixed-out photographic paper is recommended in order to prevent streaking when the varnish is applied. Photographic papers are coated, or sized, with baryta in order to provide a hard surface for the emulsion to be spread upon evenly and without streakiness. The baryta fills the pores

of the paper, like a sizing, and keeps the emulsion (or varnish, in the present instance) from sinking into the paper. The baryta coating stays in the paper whether a photographic image is made or not; as a result, it provides a useful surface for the labeling method described.

Q. On occasion, I like to take portraits at home or in the homes of friends, but almost invariably run across the problem of what to do for a plain background, which seems to be ideal. What is your suggestion for a good all-around portable background that can be rolled up and put away when not wanted?—N. L.

A. A sheet of white muslin or other white cloth will provide the greatest utility inasmuch as a varied range of background tones can be provided by the way the light source is arranged Get some half-round molding and cut it the width of your background (four feet to six feet) Cut four lengths the same size. Sandwich one end of the cloth between two of the half-round strips, nailing them together, then do the same for the other end. In use, the background is hung by a hook on a wall or tall piece of furniture, the molding at the lower end providing the weight to keep the background stretched taut, thus preventing folds and creases

Q. What is the adhesive used for binding together two sheets of mounting board to prevent curling or to give increased thickness or weight?— D. M.

A A stock batch of the following adhesive is made up for use as wanted Fourteen ounces of any good quality glue is dissolved in 26 ounces of water To this is added 1 ounce of a solution composed of one part of shellac in seven parts alcohol Keep stirring until the solution cools. One-half ounce of dextrine is now dissolved in 7 ounces of alcohol and 3 1/3 ounces of water Stir and place the vessel in warm water until the solution is comnlete The two solutions are then mixed and cooled For use, a small piece is cut off as wanted and liquefled by warming

Q. I find that in using the dry mounting method, my prints start peeling off not long afterwards. Is there any cure-all for this situation?

—F. N. H.
A. First of all, as you probably know, the tissue must be tacked to the back of the print, and print and tissue trimmed together. Tacking should be done from the center outwards and not from the corners inwards. That is, run the iron in cross lines from top to bottom and across the back of the print, leaving the corners free. Lay on the mount, overlay a sheet of pure and apply the fron from the center out. Move the fron very slowly, giving what experience must teach you is about the

right timing to do the job effectively.



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INTEREST IN FIREARMS is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers

For "Defense"!

WELL-REGULATED militia being necessary to the security of a free State, the right of the people to keep and bear arms shall not be infringed "-Article II of the 10 original amendments to the Constitution of the United States of America These first 10 amendments, known collectively as "The Bill of Rights." were proposed at the first session of the First Congress, meeting in New York City, September 25, 1789 After rati-fication by 10 of the 13 states, they were declared in force December 15.

The exploration, settlement, and growth of the United States from the wilderness it was in 1791 to the nation it is in 1940 owes so much to "the right of the people to keep and bear arms" that the statement of that obligation needs no amplification Today, privately owned guns of that era of personal and territorial protection have been almost entirely replaced by what are known as "sporting arms The nearly 7,000,000 American owners of these guns annually pay about \$12,-000,000 for hunting licenses and fees. close to \$3,000,000 in Federal excise taxes on sporting arms and ammunition, better than \$2,500,000 for Federal Migratory Bird Hunting stamps Practically every one of these dollars in this 15-million-dollar-a-year business is spent by Federal or State agencies for rehabilitation of American wildlife, which, despite misconception to the contrary, was eliminated, depleted. or endangered not by hunters, but by economic forces and activities that deprived wildlife of natural breeding and feeding grounds

As pointed out editorially on page 243 of the November issue, proponents of anti-firearms legislation have for years tried to curb "the right of the people to keep and bear arms," annually originating as many as 100 bills in state legislatures Had the last Congressional proposal passed, seven mil-lion licensed sportsmen and other private owners of arms would have (1) registered and paid a dollar fee for each gun owned or bought in the future, (2) been "mugged" and fingerprinted, (3) paid a transfer fee if a gun was sold Now, once again, this old bogey threatens, but behind its mask of "national defense" we find the same glaring and idiotic fallacy of expecting subversively - minded people to step forward and register guns held for lawless purposes

Registration of guns owned by citizens of the United States is unnecessary as a national defense measure. It cannot conceivably achieve the purpose claimed by its sponsors, because bandstry and homicide, Nazusm and Communism are practiced not by the gun, but by the man behind it. As he is notoriously known to have no use for this country's laws as they exist today, why should we believe he would respect a new one? To attempt to eliminate military weapons from subversive elements through registration of all arms, including your own sporting rifle and shotgun, would be silly, impracticable, and impossible on the face of it, but such action might result in untold injury to national defense If, as a further "defense" measure, all registered guns were to be impounded—far from an hysterical thought-we would have the ridiculous and pitiable picture of a nation that had disarmed its law-abiding citizens and which had left the lawless ones in our communities fully equipped with weapons

If, as is generally agreed, the recent Federalizing of the National Guard, and the conscription and calling of men into training indicates "A wellregulated militia being necessary to the security of a free state," then the rest of those priceless words are as applicable and as potent today as they were when written into our Constitution 150 years ago, and, if straightthinking people have their way, "the right of the people to keep and bear arms shall not be infringed '

On The Solunge Theory

Ast summer we fished a certain lake corefully and consistently from August 21 to September 1 On the 21st we were throwing back small-mouth black bass because they were too plentiful From August 28 to September 1. we frequently repeated that process. but from the 21st to the 28th we had very little action, and now, perhaps, we've found out why We've just read John Alden Knight's newest book, The Theory and Technique of Fresh Water Angling," and have not only found it packed with sound knowledge of the elements of angling, but, what is more pertinent to our spotty fishing experience, the book also contains chapters on "Habits of Fresh Water Fish" and "The Solunar Theory," the latter having been advanced by Mr. Knight some years ago.

Whether you attempt to prognosti-

cate angling luck by the tides, wind direction, moon phase, color of sunset, leaf action, bird songs, or other pet theories, or just "go fishin" you will be interested in Knight's statement that, "unquestionably the phases of the moon affect the lives and habits of all living things " Testing this thought in practice, the author established a system which worked quite well for several days each month, but the occurrence of regular lapses led him to investigate further. Following the theory of ocean fishermen that tides bring food to fish, thus establishing feeding periods, Knight felt there might be connection between feeding cycles of fresh and salt water fish This brought him to causes of the tides and consideration of sun as well as moon phases "Finally," he writes, "by discarding the tide tables and doing my own calculation of the actuating force by charting the resultant of the solar and lunar forces as anplied to the earth, I found the schedule could be made fairly accurate In so doing, the name 'Solunar' was coined -purely as a convenient term for describing the force in question. Thus was the Solunar Theory born"

Perhaps you've seen or used Knight's Solunar Tables, first published in 1935. and if so, you've formed your own conclusions Possibly you've said, "Pooey" to the whole thing The fact remains that on checking this year's Solunar Tables, which we did not have along last August, with the meticulous record of wind, weather, water and air temperatures, and time of fishing, which we did keep, we found that the Solunar periods had closely coincided with our moments of best fishing. Perhaps it's still "Pooey!" in your estimation, but the constant application of science to the unknown in angling is slowly teaching us more about fish propagation. culture and habits, fishing tackle and how to use it to best advantage Surely, we'd all be Methuselahs if we lived long enough to know all there is to know about fishing!

They Won Guns

From the amazing number of 18,000 entries in the O F Mossberg & Sons, Inc., "Rifle Name Contest," (May, 1940, Scentific American) the judges selected "Armsworth," submitted by Albert Campbell, of Richardson Park, Delaware, as prize-



winning name for the new Mossberg "M" model rifles. Second prize was awarded to Emery R. Fry, Oregon, Illinois, for submission of "Moss-K-Teer," and third award went to George H. Webster, Sheffield, Alabama, for suggestion of "Carbineer,"

a name also sent in by other entrants. Decision in the last instance was based on the best 20-word statement submitted with the entry. Each winner was awarded a cash prize and his choice of the three "M" rifles, and each chose the automatic, Model 51 M Consolation prizes were given to 15 other contestants, and after it was allower. Iver Mossberg was so gratified at the wide-spread interest shown to work even harder to give 'em the biggest gun value in the world." We still have a few catalogs showing the "M" models and other Mossberg products Want one?

"Fender Hunters" Delight

∐E once knew an old-time Michigan woodsman who had his own term for fireside hunters. He called them "fender hunters" because they never took their feet off the fire-place fender and spent most of the day and night arguing about whether wolves really attack people, how high and how fast do ducks and geese fly, are white-tailed deer frightened by a hunter's campfire, and a lot of other problematic things in woodcraft The answers to these and other famous questions will be found in a colorful. informative booklet by Goodrich Division of Hood Rubber Company It is called "Campfire Debates" and has a companion publication entitled "How Smart Are Dumb Animals?" We've a supply of each and will be glad to send them to you

POT SHOTS At Things New

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rife with cartridge of 2660 fp. velocity, low trajectory—three innées at 200 yards—is highly effective, produces sphendid accuracy and is under shooter's control at all times because trigger must be pulled and released for each shot In addition to 300 Savage caliber, "Woodsmaster" is a vailable in .30 Rem., and .35 Rem., calibers.

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ARMS AND TACKLE...



Here it is! We termed it a "magnificent publication." (See article on page 284, November)

camping, and winter sports is shown. Of special interest to fishermen will be Mershon's "Reel-Fold" line dryer, which conveniently clamps anywhere, dries two or more lines simultaneously, reverses lines end for end, coils them to any desired circumference, is rust-proof and packs into a 1½ by

101/2-inch unit for tackle box storage.

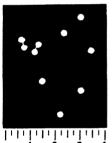
ABERCROMBIE & FITCH, in presenting their newest and customarily "tops" catalog, perfectly express our feelings about guns when they inscribe the first page "We like to believe that a fine sporting gun does more for a man than merely bring game to bag. A gun is the link between men and the out-of-doors. It is the lodestone that draws sportsmen together. It is a symbol of the woods, of relaxation around campfires, of companions who have shared adventures A good and well-used gun stands for the finest moments in a sportsman's life" The book's 136 pages are attractively covered, profusely illustrated, completely indexed, and contain every conceivable need for the gunner

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The Silvertip cartridges . . .



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A Monthly Department for the Amateur Telescope Maker Conducted by ALBERT G. INGALLS

posron, traditional home of the bean and the col, is said to have alipped somewhat in beans, but in telescope making it has come up a long way since the organization, some years ago, of the enterprising Amateur Telescope Makers of Boston Leading spirit and first president of this organization has been W H Hargbol, 600 Beech St., Robindule, Mass., (a postal station in Boston) and this country of the control of the control of the country o

Hargbol began, some years ago, the same as any typical smaleur, by making a modest first telescope, and the rest simply followed as usual by a kind of internal compulsion: he has now worked, he says when questioned, on 125 to 200 telescopes for himself and others, and he instructs in formal university extension classes at Harvard and at the Franklin Union Technical Institute. He does all his mirror work by hand

Figure 1 is an 8", f/6.5 portable, with brass-covered galvanized tube. Figure 2 is a 10", f/6.2 portable, with a tube of 3/32" Bakelite This is attached to the declination axis spider casting by means of two long rails. These in turn are attached to two end brackets screwed respectively to the

cell and to the central tube ring, so

that the tube itself does not touch any of these except the rung and cell. As Figure 2 shows, nearly half of the total tube length hes above the central rung, and this part may be rotated, the rung shown being divided in two parts Hargbol was warned in advance that such a long rotated tube end usually is difficult to maintain in accurate geometrical relation to the

lower end, and causes adjustment

troubles He therefore saw to it that

the rings received very fine machine



Figure 1: Hargbol I, 8"

taken paid well, since the arrangement has proved good. Both rings are essentially L-shaped in cross-section, the lower one having an inner, upward projection. In addition, there are six external clamps, held on by screws into the lower ring, and, between the retaining projection and the clamps, the tube end does stay where it is told to stay.

The polar axis is a solid piece of 1%" steel, the declination axis 1½". Both have thrust ball bearings.

Figure 3 is a 12½" reflector with an 175 Pyrex murror Figure 4 is its focogram with very good shadowsport as bort focal-ratio mirror Since there is perennial evidence that, despite warnings in the handbook. Amateur Telescope Making, many are not beginners, are satisfied to judge a mirror merely by visual inspection of the shadows, without actually



Figure 2: Hargbol II, 10"

measuring zones, and since this practice is very likely to lead to the production of over-corrected mirrors, some of them grossly so, readers are warned not to take away with them as a mental standard of shadow density, for application to the average mirror, the shadows of this focogram The shadows are right for this f/5 mirror but would be wrong for the average mirror with medium focal ratio Ellison emphatically points this out in "ATM," page 96 The mere distribution of lights and shadows on a mirror is not an adequate criterion of the radii of its respective parts This point is twice labored here for the benefit of the increased number of younger men - 18 to 22 - who are known to be taking up telescope making today. We have evidence that good mirrors are becoming fewer and far-



Figure 3: Hargbol and III, 12"

ther between, and some think the two facts are related. Middle-aged men are more tenacious and patient, and less interest on the transport of the transport of

The 2" polar axis shaft of Hargboll. It lesses to smouted on a tapered roller bearing at top and a ball bearing at bottom, the bearings packed in grease and provided with dust covers The photograph shows the wide, thin fina cast integral with the declination axis casting, making it very stiff—practically as stiff as it would be if the entire envelope were sold, yet much lighter Hargboll made the patterns and cove box and will be glad to the experience be gained in doing this part of the lower than the control of the patterns and cover the cover of the patterns and cover the patterns and the patter

The triangular spider at top of the



Figure 4: Focogram of III

TELESCOPTICS-

declination axis appears in Figure 3 to have an open center, which would mean weakness, but actually it is a

casting having a strong central web

The base casting of this telescope weighs 40 pounds, the declination casting 25 pounds, the tube base weighs 15 pounds, and the counterweight 56 pounds

TRAUB, not Pope, as stated, was the maker of the observatory dome shown in the October number on page 234. Pope writes to say that he doesn't want credit for another man's work Ours was the error.

TED WATTERSON, official photographer at Palomar Observatory, Palomar Mt (Yes, it's now a United States post office), Calif, made the two photographs of the 200" telescope shown in Figures 5 and 6

Figure 5 shows the upper end of the tube, 20'3" in diameter, cuddled down into the big horseshoe, 46' in diameter, which constitutes the north bearing, and pointing toward the which the horseshoe floats as it rotates show at left and right Figure 6 is a



Figure 5: The 200" telescope



Figure 6: Oll pad bearing

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The horseshoe (split ring) bearing is a Porter contribution.

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punates in Pyrex mirror disks cannot be entirely avoided, because Pyrex remains so viscous at temperatures to which it can be raised in melting (about 2800° F.) that the smaller ones haven't enough floistion power to push upward to the top and escape The manufactures therefore have to cull the disks over, throwing out the more bubbley ones Recently, we learn, they have been culling these disks more closely.

If, when the disk is ground, the grinding intersects bubbles, a thin edge is usually created and any fragments breaking loose may scratch the glass Different amateurs have used various methods of anticipating these troubles and heading them off in time (when the first break-through occurs) by reaming them out Our file on this subject shows that M J Ireland, Dearborn, Mich, used a twist drill and abrasive grains Edward P Woodcock, Long Beach, Calif, used the rear end of a twist drill or a rattail file with abrasive grains Lew Lojas, New York, put a round-head screw in a drill brace and similarly used abrasive grains Woodcock further commented "Because the bubbles do not materially affect the surface optically, they can do little harm if left alone, provided the edge looks safe from chipping, as in cases where they lie perpendicular to the face"

H H Selby, of Califorma, after having some perplexing difficulty with mysterious scratches, found bubbleto be the cause "After each wet," he says, therefore, "I dried the surface, scrubbed the bubbles hard with a toothbrush and shellar and, after ten minutes, scraped off the excess. Durter the thin edges of the glass and the shellar sealed in the fragments"

NVENTION of the telescope is generally credited to Jan Lippershay, who in 1608 arranged a convex lens in front of a concave Bell, in "The Telescope," says Lippershay's telescope was far, however, from being an astronomical instrument. In the following spring Galileo heard rumor of this instrument that made distant objects seem near, sat down and, in one evening, independently figured out an arrangement of lenses which would accomplish this end and it magnified three diameters Galileo, as Bell states, soon developed this crude beginning into a real instrument of research, magnifying 32 diameters. This telescope is on display in a museum in Florence, behind glass, and your scribe in 1928 slipped the guard there 50 cents to open the case and place a step-ladder before it, so he could climb up close for a little veneration at this fane Main credit for the invention of the astronomical telescope rightly goes to Galileo, he (1) really made something of it and (2) did important research with it Moreover, Galileo, not a meek man, fought for his discoveries and gave them publicity, when he could have kept out of hot water merely by being tactful and agreeable. This probably had very much to do with their survival.

While visiting the exhibition of the scientific achievements of Leonardo da Vinci, described on page 332, with Russell Porter, your scribe stumbled on the two grinding machines shown in Figures 7 and 8 If Galileo, who lived from 1546 to 1642, and the second where the second with the se

The machine in Figure 7 was accompanied by a label stating that it was "a model of a hand-operated machine for grinding a concave lens for a telescope or other instruments" The radius beam on the one in Figure 8 bore the label, in Italian, "Leonardo made this up to 12 meters long" The first machine has a stub lever beneath the bed-plate, with a notch on which a weight could be hung to hold the disk against the grinding wheel, just as it is shown in the photograph The remainder of the mechanism is obvious (While the lantern gear may look antique, be it remembered that



Figure 7 Design by L. da Vinci

in Leonardo's time a man couldn't simply turn to the Chicago or Boston Gear Works catalog and select a gear; he had to make his own Moreover, some of these old gears were not so inefficient as one might think). The machine in Figure 8 is crank-operated (crank at right-hand end removed in photo) and causes the convex metal photo and causes the convex metal radius beam to traverse the disk. Evidently the crank man must go into reverse after each two or three turns

At the offices of the New York Museum of Science and Industry, it was learned that Prof. Georgio Nicodemi, Director of the Department of Fine Arts of the Common of Milan, also Director of Museums in Sforza Castle and an outstanding authority and



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-TELESCOPTICS-

writer on Leonardo, had accompansed the exhibition to New York. When hunted up and questioned, through an interpreter, he said that the question of Leonardo's possible priority of invention of the telescope had been the subject of recent discussion in Italy. and he kindly offered to prepare a note summarizing these discussions

It appears that Prof Claudio Argentieri has discovered some nages of Leonardo's original notes which have not yet been published "The most surprising of Argentieri's observa-tions." Prof Nicodemi writes. "are those concerning the telescope On folio 25r, of Codice F, which is now in the Institute of France, in Paris, Argentieri noticed, under a figure of a large tube mounted on a stand, the



Figure 8 Another L. da V. design

words, 'This eyeglass of crystal must be flawless and very clear, and is to be thin in the center' The note obviously refers to a negative lens Other notes on the same sheet leave no doubt that Leonardo wished to design a magnifying instrument, and still others explain that one lens was to be plano-convex. Brief writings in Codex E and Codex A [exact references available to any interested reader -Ed | indicate that Leonardo intended his telescope for astronomical applications '

Prof Nicodemi goes on to state that Leonardo improved his telescope by using a concave mirror with a catacaustic curve but without an eyepiece The machines shown in Figure 8 might have been used for roughing out such a mirror

Since Leonardo couldn't have used a concave lens alone as a telescope, though he could use a convex, it seems possible that he had used the two in combination—that is, the arrange-ment now known as "Galilean." apparently he also used a concave mirror without eyepiece. But in any case, he omitted to publish an account of his telescopes, thus losing credit if this were his due, incidentally, delaying availability of the telescope to the world for about a century

Whether this would have opened up man's cramped horizons in Leonardo's times, as it later did in Galileo's, and accelerated the Age of Science as much, is, of course, a question Our guess is that, today, the 200" telescope would be a back number



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By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

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Labor Labels

UDGE THOMAS GLYNN WALKER of the Federal Court in New Jersey, in a decision of unusual interest, has restrained the imitation of the label of a labor union.

The suit was filed by a printingtrade union against a corporation bearing the words "Printers Union" in its corporate name The Court found that the plaintiff was a voluntary association of working men; that it had adopted a distinctive label which was registered as a trade mark for statuoney and that it permitted for statuoney and that it permitted members of the union to place the union trade mark or label upon its products.

The Court also found that the detendant, despite the fact that its corporate name included the words "Printers Union," was organized and supported by non-union printing establishments, that it had adopted a label which aimulated in many enone instance the label of the defendant had been mistaken for the label of the printing trade union The Court found that the simulation of the label constituted trade-mark infringement and that the defendant's entire course of conduct constituted unfar compeor conduct constituted unfar compe-

In reaching its decision the Court pointed out that the defendant had evidenced bad faith by seeking to represent itself as a trade union when. as a matter of fact, it was an organization supported by non-union print-ing establishments. The Court then pointed out that the defendant, having represented itself as a trade union, "then went a step further and sought to convey the impression that its label was in fact the label of" the plaintiff. It concluded that the use of the word "Union" in the defendant's corporate title, the use of a union label, the use of the words "Union label" and the use of a label deceptively similar to the plaintiff's label, "are with many of the other things herein shown by the record, the parts which, when put together, form the finished mosaic whereby the fraudulent design of the defendant is clearly spelled out.

Non-Evelusive

NON-EXCLUSIVE licensee under a patent cannot bring suit for infringement of the patent.

This question arose in a rather unusual manner in a Federal Court suit for patent infringement. After the suit was filed, the plaintiff discovered that he did not own the patent but merely held a non-exclusive license under the patent and made a motion

to dismiss the suit.

The defendant had filed a counter claim in the suit asking for a declaratory judgment, finding the patent invalid and not infringed, and sought to prevent the dismissal of the suit for the reason that he had incurred a

great deal of expense in preparing for the defense thereof.

The Court found, however, that since the plaintiff was merely a nonexclusive licensee, there was no legal controversy between the parties and dismissed the suit

Technical

when the previously pointed out that we our copyright law is highly technical and requires literal compliance therewith No portion of the law is more technical than that dealing with the notice of copyright which must be affixed to the copyrighted work. This is exemplified in a recent suit involv-

ing copyrighted advertisements
An advertising agency prepared a
series of advertisements to be used by
banks. The agency sold the advertisements to subscribing banks who reproduced the advertisements in newspages and out the advertisements in a
subscribing and out the advertisements
in a volume which was copyrighted as
a book. Thereafter a bank reproduced
several of the advertisements without
license or permission of the agency
and suit was brought against the bank

for copyright intringement
One of the defenses raised by the
bank was that the agency had falled
to affix to each copy of the advertisements, which were reproduced and
sold, the proper copyright notice required by law.

The copyright law provides in part that every copy of the copyrighted work must contain the required notice and failure to include the notice results in abandonment of the copyright. The law also provides that in the case of a book the required notice shall consist of the word "copyright" of the above the copyright of the copyright of the above the copyright of the copyright of the above the copyright of the

In the case of certain works such as prints and pictorial illustrations the law provides that the notice may consist of the letter "C" enclosed within a circle and followed by the initials of the copyright proprietor.

-LEGAL HIGH-LIGHTS-

The Court found that the bound volume of advertimements contained the proper notice required by the copyright law for books However, in actual practice, the advertimements were not published in a volume as a unit, but were separately reproduced and published. The only notice appearing on the individual advertisement was the leiter "C" enclosed within a circle together with the abvertisement was the leiter "C" enclosed within a circle together with the abvertisement was so amail as not to be legible whost the most as a small as not to be legible whost the most of seas.

The Court held that this notice did not comply with the requirements of the statute and concluded that the copyright had been abandoned. Was pointed out by the Court that the individual advertisements might well be considered as prints or pictorial illustrations and could have been copyrighted as such. If they had been so copyrighted, the form of the notice would have been proper Since, however, they had been bound together in a volume and had been copyrighted as a book, compliance with the statute required that the notice should con-sist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor

Rubber Sandpaper

A FLEXIBLE abrasive article similar to sandpaper, comprising abrasive grits or particles, held in a bond of a rubber isomer, was held to be patentable by a Federal Court

The inventor of the article had applied for a patent and the Patenti Office had refused to grant the patenti Office had refused to grant the patenti on the grounds that there was no invention involved because prior patents showed it to be old to hold abrasive grits in a bond of raw or vulcanized rubber The substitution of a rubber isomer bond for the rubber bonds shown in the prior patents, was not considered by the Patent Office to be patentiable

The inventor filed suit in a Federal Court against the Commissioner of Patents and the Court held that the invention was patentable and ordered the granting of a patent. In its decision the Court pointed out that the advantage of using a flexible rubber bond in an abrasive article such as sandpaper had long been recognized. However, prior to the invention under consideration, no satisfactory rubber bond had been developed Some of the difficulties encountered were that a sufficient bond between the rubber and abrasive particles could not be obtained, and ordinary rubber had a tendency to clog or to become gummy in use

The Court found that the use of a bond made of a rubber isomer overcame these difficulties and for the first time solved the problem of providing an abrasive article similar to sandpaper in which the abrasive particles were held in position by a satisfactory rubber bond.

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